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To Advertisers

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Monday noon to insure publication in that week's issue.

Benjamin Franklin is so well remembered as diplomat, philosopher, statesman and man of affairs that his labors as a scientist and investigator are apt to be overlooked. For this reason the article by Mr. Edwin F. Northrup, concluded in this issue of the ELECTRICAL REVIEW, upon Franklin's contributions to electrical science, possesses especial interest. It is impossible to read this account of his labors in the electrical field without astonishment at the far-seeing penetration of his conclusions and the extraordinary intelligence of his experiments. Indeed, one may be forgiven a regret that this man, though carried by the surroundings of his turbulent times into situations where his great mental equipment was of vast value to his country, might not have lived in a more tranquil age to devote his life to science, and thus enrich the world by the discoveries of another Faraday or the inductions of another Newton.

THE FUTURE OF ELECTRIC LIGHTING.

When the electric light was introduced into general use it was regarded as a luxury. Although in many respects better than any other known illuminant, there were certain disadvantages connected with it that soon began to make themselves disagreeably evident. Among these, high cost was, perhaps, the most prominent, though the great intrinsic brilliancy of the light, combined with ignorance as to the best methods for its installation, worked to prejudice many against its use for interior illumination. This was particularly true of the arc light, which was relegated almost entirely to outdoor service on account of its intense brilliance, its unsteadiness and its disagreeable color.

With the progress of invention, however, many of the detrimental features of electric lighting were eliminated. The incandescent lamp has been greatly improved in life and efficiency and its price has been reduced to what seems to be the practical minimum. Enclosed arc lamps have removed, by one stroke, the principal disadvantages of arc lighting, rendering it desirable for interior work and reducing the cost and improving the steadiness of the light. Experience in installation has taught the best methods of applying the light to produce given results, and methods of generation and distribution have been revolutionized to the great improvement of central station service.

All the time that this advance has been in progress the receipts of gas companies, the natural rivals of electric lighting plants, have grown. This is partly due to an increased use of gas for cooking and heating, but largely also to better methods of production and utilization of gas. Water gas, cheaply made, has taken the place of coal gas, and the brilliant invention of Dr. Auer von Welsbach has resulted in a burner of astonishing efficiency. Notwithstanding this, however, electric light is unquestionably the best artificial illuminant known to-day, and the question most interesting to members of the electrical profession at present is how to improve it so that it will remain the acknowledged superior, and, at the same time, how to cheapen it so that it shall retain commercial supremacy in the field of illumination.

At present there are but two competitors of electric lighting—gas and oil. The latter is used in places where neither gas nor electricity is available and to a limited extent in residences as an ornamental light, much as candles are occasionally seen burning in luxurious interiors to heighten some effect of decoration transposed from a remoter century. Gas is ubiquitous in cities, and is the chief rival of the central station.

The Welsbach light has three striking disadvantages—its hot and disagreeable products of combustion, its color and the extreme fragility of the essential part of the burner. Added to these are the rapid deterioration in efficiency of the mantles employed and the fact that the lights must burn right side up and where the hot gases from them may find vent.

On the other hand, the light is steady, powerful and cheap, and, doubtless, the entire suppression of the ordinary open flame burner in its favor, allowing the gas companies to supply unenriched gas (gas burning with a pale flame but excellent for cooking or in mantle burners) will make it even cheaper. Here, then, is what the electric light station will probably have to face some day—very cheap incandescent gas burners, requiring matches to light them, giving off hot and noxious vapors, and requiring the introduction of a fire risk of the first class wherever the lights are installed.

There are no less than three directions visible to-day along which progress will place the electric light in an impregnable position. The electrolytic oxide lamp of Dr. Nernst holds out large promise; the seizure of the Welsbach principle and its in-

corporation in the ordinary incandescent lamp is another direction in which hopeful progress has been made; the perfection of the enclosed arc lamp in small sizes is still another prospect of advance.

With its recognized defects the electric light of to-day is still better than anything that the progress of invention in gas lighting seems to promise, save in the one element of cost. It is sufficiently evident that the cost of producing electrical energy—certainly so long as mechanical prime movers and dynamos are used in the process—is near its minimum. It is, therefore, to the translating device that we must look for progress, and already that progress is at hand. In no less than three directions encouraging prospects for the decided improvement of electric lighting are plainly visible, and the future of the industry seems full of promises.

THE ABUSE OF "ELECTRIC WIRES."

It has become habitual for fire department officials to ascribe the cause of any mysterious fire to "electric wires." This is probably because a certain pride prompts the suppression of "unknown" as the cause, and also because, the evidence being destroyed in the conflagration, nobody can prove the contrary when the fault is laid at the door of the wireman. It is not unlike the practice of some physicians who call by the name of "heart failure" any sudden and fatal illness not fully understood by them. The difference is that the prevalence of heart failure as a cause of death only adds to the revenues of life insurance companies from people who are easily alarmed, while the libel on electric conductors is working a real damage to a useful industry.

Nobody can deny that electric wires have been responsible for fires, and that they may be again. But nobody who knows anything about modern methods of wiring believes that they contain any element of real danger. The inspection that has been maintained in important centres of population by building departments, fire departments and insurance companies alike has certainly been sufficient to minimize the fire risk from electrical installations. If an equal care had been given to gas pipes we would have fewer mysterious fires.

Doubtless the fashion of charging the wire with responsibility for conflagrations not easily understood will some day be changed. Fifteen years ago the rule was that "spontaneous combustion" was to blame when the fire department could find nothing else to bear the burden; for it is very important to have a complete story for the reporters after a fire, and its origin is a matter that must be understood or professional reputation is involved. When wiring became general the fires from spontaneous combustion grew noticeably fewer and "electric wires" began to be heard from. Some day something else may be found as the scapegoat, or it is even possible that some strong-minded fire marshal may inaugurate a new custom altogether and give the origin of a mysterious fire as "unknown."

All the time that electric wiring has borne the burden of this obloquy the leaking gas pipe has gone on swelling its list of property destroyed and victims cremated. It is to be hoped that the far greater dangers inherent in pipe systems for gas than in electric conducting systems may some time bring about an inspection for them at least as thorough as that demanded of wiring. And it must not be forgotten that the electric wire is the fireman's best aid and the insurance company's mainstay. Without an electric fire-alarm system a city like New York would be lucky if a week passed without a disastrous conflagration.

ACTIVITY IN FOREIGN TRADE.

Export houses and foreign correspondents report increasing activity in foreign trade. The Winter is over and the closed-up rivers are becoming rapidly opened to navigation, even in the northern part of Europe. With the Spring construction work is begun actively throughout the world, the ground softens up, excavations are made and the foundations for power plants and other buildings are laid. American enterprise manifests itself in countless applications of electrical apparatus to manufacturing industries. Most of the foreign orders that have come in so far have been for electric railway and lighting material. People must communicate with each other; they must have street railway cars; the various towns and cities require illumination. Americans appear able to produce such material and equipment for considerably less money than their competitors, and when it is considered that we have frequently delivered abroad finished products at a smaller selling price than the local competing manufacturer can produce a similar article for, the reason for our rapid and substantial advance is clear.

THE INSTITUTE CONVERSAZIONE.

The new departure inaugurated by the American Institute of Electrical Engineers last week by the holding of a *conversazione* at Columbia College was a most gratifying success. Indeed this might well have been expected, both because of the intelligent labors of the committees who had the matter in charge and the general interest that had been awakened regarding this variety of gathering. In other columns will be found a complete description of the interesting exhibits which were shown to the members and their friends on this occasion. It is invidious to particularize any one of these specially, but it is exceedingly pleasant to chronicle that there were shown several inventions which promise to be of epoch-marking importance. The Institute may well be congratulated upon the interest and scientific value of the apparatus and systems which were shown by its members, many of them for the first time.

It is greatly to be hoped that such meetings will become a feature of the regular life of the Institute. The annual Summer meetings have been, up to now, the most interesting features of the Institute's work, and it is to be hoped that these may be supplemented by Winter meetings of the same character as that so successfully held last week, thus stimulating interest in the Institute itself and enlarging greatly the sphere and scope of its activity and usefulness.

The interesting series of papers by Professor W. E. Goldsborough, on "Alternating-Current Dynamo Electric Mechanism," will be resumed in the columns of the ELECTRICAL REVIEW next week. Those who have followed this series of papers have seen that, by the simple analytical and graphical methods employed, Professor Goldsborough has been able to reduce the mathematical discussion of alternating-current problems to exceedingly simple terms, requiring no very elaborate acquaintance with mathematics on the part of the reader to follow it easily.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE "CONVERSAZIONE," HELD APRIL 12, AT COLUMBIA UNIVERSITY, A BRILLIANT SUCCESS.

The members and friends of the American Institute of Electrical Engineers took possession of Columbia University, New York city, on Friday evening, April 12. They were brought together by the announcement of an exhibition, with social features, of important and modern electrical apparatus.

The committee of arrangements was composed of W. S. Barstow, chairman; Edward Caldwell, W. J. Hammer, R. T. E. Lozier, T. C. Martin, Calvin W. Rice, George F. Sever and Dr. Francis B. Crocker. The reception committee included Carl Hering, president; T. C. Martin, Edward Weston, Professor Elihu Thomson, Professor W. A. Anthony, Professor A. Graham Bell, John W. Lieb, Jr., Charles F. Scott, L. B. Stillwell, Herbert Lloyd, Dr. Samuel Sheldon, Charles S. Bradley, Dr. Michael I. Pupin, W. S. Barstow, John J. Carty, Edward Caldwell, William J. Hammer, Ralph W. Pope, Frank J. Sprague, Dr. Edwin J. Houston, Dr. Louis Duncan, Dr. Francis B. Crocker, Dr. A. E. Kennelly, Gano S. Dunn, Arthur V. Abbott, W. L. R. Emmet, George F. Sever, Charles P. Steinmetz, William D. Weaver, C. O. Mailloux, Calvin W. Rice, Ralph D. Mershon, R. T. E. Lozier and George A. Hamilton.

The ELECTRICAL REVIEW believes that no two committees ever worked harder or are deserving of more praise for the brilliant success of a timely conception.

The attendance was quite large, between 2,000 and 3,000 people being present, at least one-half the number being ladies, who took great interest in the various exhibitions and the explanations given by the gentlemen in charge. Among these present, besides nearly every member of the committees named, were Seth Low, president of Columbia University; Carl Hering, president of the American Institute; Thomas A. Edison, Professor Elihu Thomson, Nikola Tesla, Dr. M. I. Pupin, E. H. Mullin, Charles W. Price, E. F. Peck, Charles E. Dustin, Royal C. Peabody, H. Ward Leonard, Peter Cooper Hewitt, Professor W. S. Franklin, George C. Maynard, Captain E. L. Zalinski, W. S. Mallory, H. J. Sanville, L. Stieringer, H. C. Townsend, Dr. S. S. Wheeler, Geo. G. Ward, Martin J. Insull, Dr. Leonard Waldo, C. O. Mailloux, Geo. W. Hebard.

Much interest was taken in the experiments with the electric oscillator given by Mr. Tesla in Havemeyer Hall. Mr. Tesla was applauded by the assembled audience when he entered the room, as was also Mr. Edison when he came in a few moments later. The Columbia College boys gave both gentlemen ringing cheers. An enjoyable collation was served later in the evening.

Below is given, somewhat in detail, the various exhibits, the names of the gentlemen presenting each and a brief description:

Mr. W. S. Andrews:

1. Revolving spark experiment, showing oscillating discharge occurring rapidly during the same half wave and proving that a short-circuit in a high-potential current containing inductances and capacity ruptures itself instantly.

2. Luminous aluminum cell.

Mr. E. V. Baillard:

1. Faradmeter—A portable and convenient instrument for measuring electrostatic capacity.

2. Bridge for measuring low resistances.

Professor George F. Barker and Professor Arthur W. Goodspeed:

Radiographs illustrating special features of Rœntgen-ray phenomena.

Mr. Charles L. Clarke:

Synchronism and phase indicator for indicating when two alternating-current machines are in synchronism and the phase relations of their electro-motive forces. It is also applicable for showing the lag of a current behind the electro-motive force, either in the same or another circuit, provided they have equal frequencies, and also for showing the phase relations of currents of the same frequency. The instrument, as exhibited, which is intended for use in lighting and power stations, consists of two synchronous alternating-current motors, which respectively drive two stroboscopic disks, the stroboscopic image formed opposite a scale indicating when the generators respectively supplying current to the motors are in synchronism or nearly so, and, in the latter case, which of the generators is running at the greater polar speed. When the generators are in synchronism, the stroboscopic image is stationary, and its position relative to the scale indicates the degree to which the electro-motive force of one generator leads or lags behind the electro-motive force of the other.

Mr. A. F. Clift:

Telpherage system for the transportation of freight in small bulk, express matter, mail, etc., by means of an electric motor traveling upon an overhead cable obtaining current by rolling contact with a lighter wire above.

Dr. Francis B. Crocker:

Magnetic liquids, with apparatus in operation for showing the magnetic properties of liquids and for measuring their permeability.

Mr. H. P. Davis:

Two switchboard panels, showing principally a phase shifting transformer, a power factor indicator, a synchronizer, an alternation meter and various new indicating and integrating instruments.

Professor W. S. Franklin:

Magnesia arc lamp—An electrolytic lamp, on the Nernst principle, operating on 1,000 volts.

Dr. William E. Geyer:

Incandescent lamp experiments—Experiments employing incandescent lamps on circuits containing self-induction and capacity.

Mr. Caryl D. Haskins:

1. Power factor indicator showing relation between real and apparent energy in an alternating-current circuit.

2. Single coil astatic instruments—Instruments which, instead of using four coils, employ only one.

Mr. Peter Cooper Hewitt:

High power electric light from gases—1. One large tube lamp 500 to 1,000 candle-power lighting the room, using ordinary 115-volt direct current.

2. Experiments illustrating the conduction of electricity by gases.

3. Apparatus showing the relation of voltage to length and diameter of tube.

Mr. William J. Hammer:

1. European "Nernst" and other electric lamps.

These lamps were shown in operation during the evening.

2. Mr. Waldemar Poulsen's telephonograph or telegraphone, exhibited by Messrs. Lemvig Fog and Emil S. Hagemann, of Copenhagen, Denmark, and Mr. William A. Rosenbaum, of New York.

3. Collection of aeronautical pictures, comprising photographs of Professor S. P. Langley's Aerodrome, Sir Hiram S. Maxim's Flying Machine, Santos-Dumont's Dirigible Air-Ship and Count Zeppelin's Balloon; together with balloon tests made during the Aeronautical Congress, at the Paris Exposition of 1900, and by the Aero Club of France. Most of these photographs were taken by the exhibitor.

Mr. A. S. Hubbard:

1. Positive and negative plates, the Gould storage battery, having small amount of active material, which have gone through a series of charges and discharges, at half-hour and 20-minute rates.

2. An automobile battery cell with a "spinning," giving 450 square inches of surface per pound of lead.

3. A positive and negative plate of automobile type of cell.

4. An unformed plate with delicate "spinning," giving 144 square inches per cubic inch of lead. The feature of the battery is the increase of superficial area of the plate obtained by spinning or grooving with rotary knives, which force the lead up between them, forming ribs and grooves of any desired dimensions.

(Continued on page 498.)

Science Brevities

A New Storage Battery—The new storage battery of M. Ernst Junger, which may be used also as a primary element, has the peculiarity of an electrolyte that does not vary in composition or concentration, the water alone being decomposed. This action is brought about by the use of potassium or sodium hydrate, whose metallic bases decompose water; and for the active material of the plates metals were used whose hydroxyl combinations can not exist in presence of water, but are decomposed into oxide and water, says a British contemporary. The active matter is supported upon plates of metal, preferably nickel or copper, whose oxides are not soluble in alkali. To illustrate an element of this kind, the positive plate may be of nickel, plated with peroxide of silver mixed with cement to give consistence; the negative is a copper plate upon which has been compressed a layer of finely divided copper. These electrodes, separated by a layer of asbestos paper, are placed in an ebonite cell, with an alkaline solution as electrolyte. The expense is reduced by using ferrous oxide at the negative plate and black oxide of manganese at the positive. As an accumulator, this element holds its charge a long time, and it seems to be unaffected by temperature changes.

Inaccuracy of Atomic Weights—Owing to the fact that the values obtained for the atomic weights of iodine and tellurium are inconsistent with their relative positions in Mendeléeff's table, numerous determinations of the atomic weight of the latter element have been made in recent years, the results obtained varying between 127.5 (Staudenmayer) and 128 (Wills), all being above that of iodine (126.8) instead of below it as required by the periodic law. As is pointed out, however, by Herr O. Steiner, all these determinations of the atomic weight of tellurium are based upon the analysis of inorganic preparations, the methods of purification adopted giving no complete guarantee that small quantities of substances of similar properties but different atomic weights may not be present. The fact that tellurium forms a stable and well-defined diphenyltelluride, $Te(C_6H_5)_2$, distilling without decomposition in a vacuum, was therefore utilized for a fresh determination. Although these preliminary results have not the high degree of precision necessary for the complete resolution of the problem, Herr Steiner points out that the accuracy obtainable by an ordinary combustion is sufficient to fix the atomic weight of tellurium to within 0.5, and several results obtained by combustion of the carefully fractionated product gave a mean value of 126.4, a figure much lower than those mentioned above and agreeing with the prediction of the periodic table. As a confirmation of the method, a similar set of experiments upon diphenylselenide gave the values 78.8 and 79.3, the number usually adopted being 79.1. The results of more exact determinations carried out upon material purified by this method will be awaited with interest.

Crystallization—An interesting review of Tammann's theory of the fusion of a crystalline solid is thus abstracted in *Engineering*. This theory would seem to have a possible bearing on practical metallurgy. The question raised by Tammann was whether a crystalline solid could be reduced to the liquid state, without at one period of the transformation existing partly as solid and partly as liquid. When ice melts there is always a time, generally somewhat prolonged, in which the mass is partly ice and partly water. Similarly, when a liquid evaporates there is a period during which the mass is partly liquid and partly vapor. We know, however, that a liquid can be converted into gas or vapor, by a perfectly continuous process, without passing through an intermediate stage in which it is partly liquid and partly gaseous. To effect the change in this way, it is merely necessary to keep the liquid under a sufficient great pressure, and raise its temperature above a certain critical point. The pressure is then reduced to the proper degree, and the temperature lowered to its initial value, when the whole of the substance will be found in the gaseous state. Now, Tammann's experiments, so far as they go, tend to show that there is nothing analogous to this in the change of a body from a crystalline solid to a liquid. With solids which are not crystalline, plastic fusion may occur; but in the contrary case there is always a period during the change of state, in which one can definitely state that part of the body is crystalline and the other part is liquid. This change from a crystalline structure to an amorphous one is commonly brought about by raising the temperature of the body; but Tammann's experiments tend to show that the change from a crystalline to an amorphous structure may also be brought about by reducing the temperature, and the substance then becomes a vitreous solid like glass. As is well known, a homogeneous body of this nature fuses gradually by passing through a pasty state, and the passage from the solid to the liquid condition is therefore a continuous one. This tendency for a solid to lose its crystalline character with a reduction of temperature is naturally a difficult one to observe, since the rigidity of the body, which increases as the temperature is lowered, tends to prevent such a change. The theory, however, leads to the conclusion that a body which naturally tends to crystallization on solidifying could be prevented from doing so, by making the change of state occur under a sufficiently high pressure. Though there are difficulties requiring further investigation, some facts in metallurgy seem to us to lend countenance to this hypothesis. Tammann's own experiments, however, appear to have been made wholly on certain organic salts; and in several cases he has obtained definite evidence of this assumed tendency for bodies to lose their crystalline structure as the temperature is reduced. It should further be noted that on the same theory a metal will tend to crystallize if it is maintained at too high a temperature and at too low a pressure.

A New Coal Calorimeter—Mr. Samuel W. Parr, in a recent paper, describes this apparatus, which, he claims, differs from those usually employed in that no gaseous oxygen is required, the coal being burnt by means of sodium dioxide, says the *Electrical Engineer*. The carbon dioxide and water produced are absorbed by the sodium oxide formed. From an abstract of Mr. Parr's paper, contained in the Chemical Society's *Journal*, it seems that one gramme of the sample, dried at 150 degrees, is mixed with 17 grammes of sodium dioxide; the mixture is put into a cartridge which is placed into an insulated vessel containing a certain volume of water of known temperature. The charge is fired by means of a red-hot copper wire, the increase in temperature is noticed, and the usual calculation made. For exact particulars of the construction of the apparatus and the cartridge, the illustrations of the original paper should be consulted. An allowance of 27 per cent of the total indicated heat must be made on account of the heat developed in the combination of the carbon dioxide and the water with the chemical employed. An allowance must also be made for the use of the hot copper wire; the average of many determinations on various lengths up to two inches established a fairly uniform factor of 0.012 degree per one-half inch of No. 12 copper wire.

SYSTEMS OF ELECTRIC TRANSMISSION AND DISTRIBUTION—III.

BY CHARLES P. STEINMETZ.

V.

FREQUENCY OF ALTERNATING-CURRENT SYSTEMS.

a. While the decision between continuous and alternating current in most cases meets with no serious difficulty, one of the most difficult questions, in the case of using alternating currents, is the choice of the proper frequency.

Available as standard frequencies are 25, 40, 60 and 125 cycles. The latter frequency is used only in smaller systems, since at 125 cycles self-inductive effects are already so considerable as to make this frequency undesirable for systems of larger size, and for motors.

For lighting, a high frequency is best suited. For converters and direct-connected, slow-speed generators, a low frequency is best, while for motors, all frequencies are more or less suited.

Incandescent lighting becomes feasible at 25 and satisfactory at 30 cycles. Arc lighting is feasible at 40 and satisfactory at 60 cycles, but still better at 125 cycles, at which latter frequency the extinction of the arc during the reversal of the current is less noticeable than at lower frequencies, where it makes itself felt on moving bodies by giving a number of successive images of them.

Stationary transformers obviously are more efficient and smaller, thus cheaper, with higher frequency, and very small transformers, as required for individual lighting in scattered districts, become rather undesirable below 60 cycles. With large and very large transformers this difficulty is much reduced, since the efficiency of large transformers is so high at any frequency that the difference between low and high frequency becomes unimportant, and the cost of transformers is small compared with that of the rest of the systems.

b. Induction and synchronous motors can be built almost equally well for all frequencies up to 60 cycles. Beyond this, the design of large induction motors becomes difficult, due to the very large number of poles required to get reasonably low speed. Naturally, the higher the frequency is, the greater must be the number of poles of the motor, even if a higher speed is chosen. With induction motors of very small size a higher frequency is rather preferable, since it permits the use of higher speeds and thus smaller motors, while with 25 cycles the four-polar motor has already 750 revolutions, which is a rather expensive speed for motors of a few horse-power. For large induction motors, however, of several hundred horsepower, 25 cycles is decidedly preferable to higher frequencies, especially if low speed is required. Very low speeds, as 100 revolutions or less, can not economically be reached by higher frequency induction motors, and hardly even with 25-cycle motors, since, due to the need of a distributed winding in the induction motor, the diameter per pole can not be reduced below certain limits, and thus with low speed and a very large number of poles the diameter of the motor becomes very large. With synchronous motors this difficulty exists to a much lesser extent. In synchronous motors a unitooth construction of the armature can be used, and thereby a very small diameter per pole employed, so that synchronous motors can economically be built with many more poles; that is, lower speeds, than induction motors. But even with synchronous motors of large size and moderate speed, 25 cycles is preferable.

For certain sizes of induction motors, moderate speed motors of moderate size, as used for driving factories, mills, etc., 40 cycles is best suited, and this frequency has thus been adopted for this class of work, since it is suitable also for direct lighting.

c. For converters, 25 cycles is the most desirable frequency. Numerous converters have been built and are in satisfactory commercial operation at frequencies of 60 to 66 cycles, and under favorable circumstances even higher frequencies could be used. But, however satisfactory such high frequency converters may be, they can never be as good and as reliable as 25-cycle machines. The converter is essentially a commutating machine; that is, its predominant feature is the commutator. Since, however, converters must run in synchronism with the frequency of the alternating current supplied, it follows that their armature must move over the distance from pole to adjacent pole, and their commutator surface the distance from brush to adjacent brush during one-half wave of current; that is, in one-fiftieth of a second with 25 cycles and in one one-hundred and twentieth of a second with 60 cycles. Good mechanical, and still more good electrical design, requires, however, as low a peripheral speed of the commutator as possible, so that the available distance from brush to brush on the commutator surface is limited by the frequency. Good commutating machine design requires that the average voltage per commutator segment should be low; that is, the number of commutator segments per pole large, and that the segments should be as wide as possible. This is quite feasible with moderate commutator speeds at 25 cycles, but not any more at 60 cycles; but for the latter frequency high peripheral speed, high volts per segment, and narrow segments have to be used. As comparison, it may be considered that the average frequency of continuous-current machines varies from six cycles for large low-speed units to 20 cycles in high-speed machines, so that in converters, where due to the absence of armature reaction the conditions of commutation are more favorable, 25 cycles is still within conservative limits.

Sixty-cycle converters must necessarily have a large number of poles and high peripheral speed; that is, high momentum and a low armature reaction, while the opposite features are best suited for stability of operation.

The result hereof is that at frequencies above 25 cycles the six-phase design of converters is always preferable, since it permits the use of higher armature reaction and lower peripheral speed, and that for 60 cycles motor generators are preferable to converters, except under favorable conditions of operation, and even at 40 cycles frequently motor generators are used instead of converters.

d. For high-speed generators all frequencies are equally suited, and at very high speeds 25 cycles may even be unsuitable and too low. For low-speed generators, as steam-engine driven direct-connected units, the lowest frequency is most desirable regarding parallel operation and operation of synchronous apparatus, such as motors and converters.

The steam engine does not inherently give a uniform rate of rotation, but a number of impulses per revolution. By proper balance of the work of the engine cylinders in a multiple expansion engine, and of the momentum of the moving masses, this inequality is reduced as far as possible, and is still further reduced by the flywheel. But a certain inequality or variation of speed during the revolution necessarily remains. Experience has shown that satisfactory parallel operation of synchronous apparatus requires that the deviation of the alternator from uniform rotation should not exceed two and one-half to three degrees of phase, when running alone, as well as when running in multiple with other alternators. This means that the greater the number of poles is, the greater must be the uniformity of rotation of the engine. Thus, a 75-revolution engine, which, with

a 40-polar, 25-cycle alternator, gives a deviation of two and one-half degrees in phase, would with a 60-cycle, 96-polar machine give a deviation of $2\frac{1}{2} \times 60/25 = 6$ degrees, and thus a much better engine or a much heavier flywheel would be required at 60 cycles than at 25 cycles, to give the same uniformity of frequency. The engine governor, however, inherently tends to hunting, especially with the engine running in multiple with other engines, and this the more the greater the weight of flywheel, so that excessive weight of flywheel is objectionable. The consequence hereof is that with increase of frequency the difficulty in designing engines of sufficiently uniform rate of rotation, which do not hunt, very rapidly increases, and the lowest possible frequency is therefore desirable.

e. It follows herefrom that the requirements of the different parts of an alternating system regarding frequency are antagonistic. Lighting and small transformers require a high frequency; low-speed generators and converters a low frequency.

Occasionally, by the adoption of 40 cycles, a compromise can be effected, but more frequently such a compromise frequency is less desirable, as not best suited to either of the conditions; that is, too low for lighting and too high for generators and converters. Hence, a decision has to be made between the 25-cycle system with low-speed generators and first-class converters, operating alternating lighting through motor generators or frequency converters, or the 60-cycle system with generators of higher speed and greater sensitiveness, directly operating alternating lighting, but supplying the direct-current service by motor generators, or rotary converters of a less satisfactory nature. In most large systems, investigation and experience have shown the 25-cycle system as decidedly preferable, especially due to the greater satisfaction in parallel operation of slow-speed generators.

For high-frequency, long-distance transmission, all frequencies are equally suited, as long as the voltages are not so high and the distance so great that the charging current of the line as condenser becomes of noticeable magnitude. In the latter case, however, where the capacity effects of the line become of importance, the lowest possible frequency, say, 25 cycles, is desirable or even essential.

VI.

NUMBER OF PHASES.

a. Less difficult than the choice of the proper frequency is the decision on the number of phases of the alternating system to be used.

Available are:

1. The single-phase system.

2. Modified single-phase systems, as the monocyclic system, and compound systems, as the polycyclic system, of single-phase lighting with three-phase power.

3. The polyphase system, either as three-phase or as quarter-phase system.

The difference between three-phase and quarter-phase is of less importance, since any polyphase system can be transformed into any other polyphase system at full efficiency by means of two stationary transformers.

For direct alternating-current lighting with incidental power, the single-phase system is decidedly the simplest and thus best, since, with this system, no need exists of balancing the load between different phases, and two wires are sufficient for primary as well as secondary feeders.

The single-phase motor, however, is larger in size, and therefore cost, and lower in efficiency than the polyphase motor, and where a considerable motor load is anticipated, systems of single-phase lighting, with additional power wire for motors, are therefore used.

But far more flexible for general work of all kind is the polyphase system, and where long-distance transmission, conversion to continuous current, operation of large self-starting synchronous and induction motors come into consideration, polyphase systems are employed.

b. At 25 cycles, direct lighting is necessarily excluded, and the load consists of conversion to continuous current, or to alternating current of higher frequency, and induction and synchronous motors. Therefore, exclusively polyphase systems are used at this frequency, and in view of its higher efficiency in high-voltage transmission and distribution, with the exclusion of only the Niagara plant, always the three-phase system is used, and even at Niagara that part of the power which is transmitted to a considerable distance is transformed to three-phase.

Forty cycles is chosen, either as compromise frequency to permit direct alternating lighting on a general system of generation and conversion, and then for the same reason as in the 25-cycle system, the three-phase system is almost exclusively used. Or 40 cycles is chosen for power distribution to smaller, moderate-speed motors, in factories and mills, with incidental lighting, and in this case a polyphase system is required and the three-phase system used as more economical in distribution and transmission, although the lighting is frequently connected to one phase of the system only as single-phase load.

At 125 cycles, transmission to greater distances and extensive motor work are less feasible, due to the higher inductive effects with this frequency, and 125 cycles are exclusively used for moderate-size alternating distribution for lighting with incidental power by small motors and with small individual transformers. Therefore, the single-phase system is almost exclusively used as simpler and thus better suited for this class of work than polyphase systems.

It thus follows that inherently and due to the nature of load, 25 and 40-cycle systems are three-phase, and 125-cycle systems single-phase, and the question of the proper number of phases requires further consideration only for the 60-cycle system.

c. Sixty cycles is the frequency best suited for general alternating-current distribution, by means of secondary mains or a secondary network fed by large transformers, for incandescent and arc lighting and motors, mostly of the induction type, while synchronous motors become preferable only in very large units.

Here the efficiency of low-tension alternating distribution becomes of importance. To secure similar economy of conductor material, as afforded by the three-wire Edison continuous-current system, with alternating current, at least four wires are required.

Collective Exhibit at the Pan-American Exposition.

Under the general direction of the electrical section of the Pan-American Exposition, Mr. W. J. Marland, of 132 Nassau street, New York, is preparing a collective exhibit which will present many interesting features. This exhibit is intended to show such manufacturers as occupy small space and which, for one reason or another, are better shown collectively and in connection with one another than separately. It is the purpose of Mr. Marland to show as many as possible of the appliances gathered together here in actual operation, and it is believed that the section under his control will be one of the most interesting in the exposition. Already arrangements have been made with a large number of manufacturers looking to the gathering in this division of operative devices ranging over practically the whole field of applied electricity.

THE CONSTRUCTION OF SMALL TELEPHONE EXCHANGES—VIII.

BY A. E. DOBBS.

POT-HEAD TERMINALS.

While on this subject of terminals there is a form that is still used a great deal by at least one of the Bell and some independent companies known as the "pot-head" and shown in Fig. 33, which consists simply of a sleeve slipped on the end of a paper cable and connection made to the outside by means of rubber-covered wires, after which the sleeve is filled with insulating compound, the top end battered together, and the wires wound for an inch or so with friction tape to keep them from spreading. After this they are distributed to the strips, *s s*, along the sides.

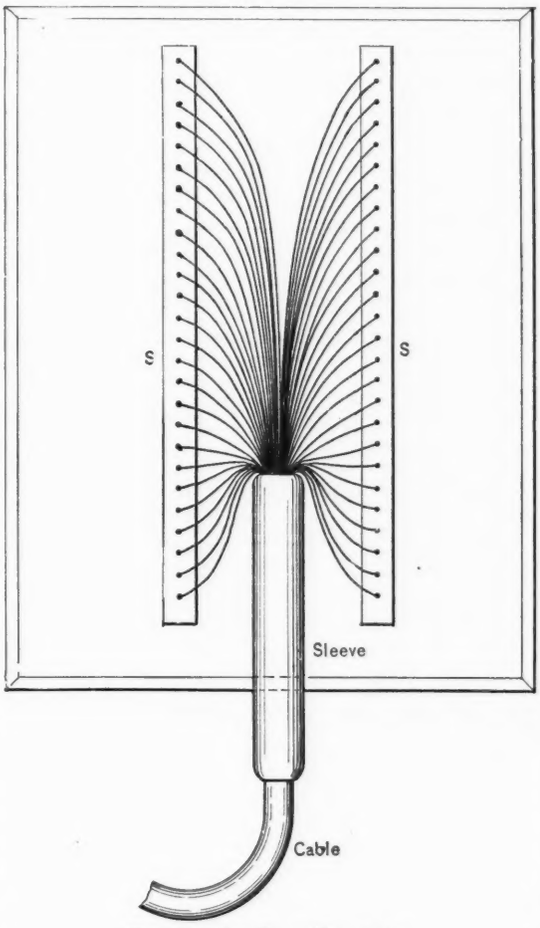


FIG. 33.—POT-HEAD TERMINAL.

NOT TO BE FORGOTTEN.

As has been said before, it should not be forgotten that the different colored wires that constitute a twisted pair should be arranged systematically throughout the system in order that there may be no confusion in connecting to the switchboard, or finding the "tip" or "sleeve" wires outside.

Let it be agreed, suppose, that the white wire of each pair shall take No. 1 in the terminal. This would throw the red wire to No. 2 and this should be followed strictly throughout the whole system. "White be odd and red the even numbers." This plan should also be carried through the terminal and switchboard room, right up to the board where the white wire will end in the "tip" and the red the "sleeve" springs of the jack. On the lines outside the same order would also prevail. Odd numbers the tip and even the sleeve.

POLE SPIDERS.

As said before, the pin numbers on the pole should take the same numbers as their cable connections and the best way to insure this and also save time is to have the pole spider made and lashed in the shop. As one man can make several of these in a day there will not be much time lost.

In order to do this, make a frame of several boards four inches wide and ten feet long, spaced exactly as the cross-arms on the pole, with nails driven into them at the place where the pins would come, which, in Fig. 34, are 12 inches apart with 16 inches in the centre. This makes a permanent templet for the forming of pole spiders. Wire used for this purpose should be of No. 16 or 18 B. & S. gauge, rubber-covered and braided single wire. The distance from the arms to the cable box can be measured or estimated—and they should be all placed about the same—and a length of wire left below this frame sufficient to reach to the top of the cable box after making the turn from the bottom. Allowance should also be made for taking a turn around the pin at the upper end.

After the wires have all been strung out on the frame, they should be lashed to insure their retaining their positions; when this is done two boys with a call-bell and a battery can test each wire in turn and tag the numbers at the lower end, after which the spider is all ready for putting up, with little chance for mistakes, except, perhaps, that of turning the spider wrong side to on the pole.

Electric Street Railways in Cardiff.

Reports from Wales state that electrical tramways have at last obtained a footing in Cardiff, and that the sleepy old town has ordered the construction of a power station, car depot, tracks and a complete system. The foundations for the power station are already completed and the tracks are being laid as rapidly as possible. For the tramway purposes four 500-horse-power engines will be employed, each capable of handling considerable overload. The generators are of 300-kilowatt capacity and able to withstand an overload of 50 per cent. The whole energy developed at the station will be delivered from the generators to the main switchboard which runs across the whole end of the engine room. The cables transmitting the power are to be laid in underground vitrified conduits of sufficient capacity to provide for 30 cables in the future.

Germany as a Leader in Fast Electric Traction.

Privy Councillor Rathenau, who is also the superintendent of works for the Allgemeine Elektricitäts-Gesellschaft, had a talk with Kaiser Wilhelm on January 14 regarding the construction and operation of fast electric railway lines throughout the German Empire, giving his sovereign detailed information on the subject, dealing with both freight and passenger traffic. Herr Rathenau's proposition was recounted briefly in the ELECTRICAL REVIEW shortly after his conference with the Emperor, and the consular report, giving the necessarily fuller details, is of interest. This report states that speeds of 125 or 150 miles an hour may possibly be obtained for passenger service, but that for the present, at least, steam will continue to be the motive power for freight trains. If the experiments are successful and the plans carried out as proposed the long, dreary ride from Berlin to Hamburg will be accomplished in a trifle over an hour, in single car trains which will be despatched at 10-minute intervals. The average speed for fast trains on German railways is now 37 miles an hour under favorable conditions.

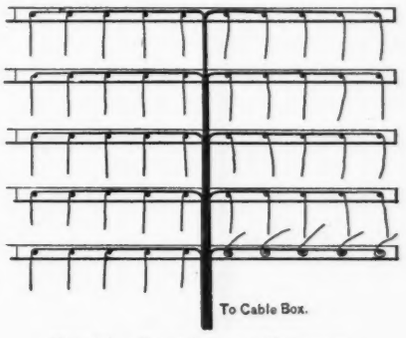


FIG. 34.—POLE SPIDER TEMPLET.

BENJAMIN FRANKLIN'S CONTRIBUTIONS TO ELECTRICAL SCIENCE—IV.

(Concluded.)

BY EDWIN F. NORTHRUP.

FRANKLIN'S ONE-FLUID THEORY OF ELECTRICITY.

Franklin's theory of the nature of electricity has been so precisely and clearly stated by himself that we can not give a better understanding of it than by quoting his own words regarding its essential aspects:

"Opinions and conjectures concerning the properties and effects of the electrical matter, arising from experiments and observations made at Philadelphia, 1749."

1. The electrical matter consists of particles extremely subtile, since it can permeate common matter, even the densest metals, with such ease and freedom as not to receive any perceptible resistance.

2. If any one should doubt whether the electrical matter passes through the substance of bodies, or only over and along their surfaces, a shock from an electrified large jar, taken from his own body, will probably convince him.

3. Electrical matter differs from common matter in this, that the parts of the latter mutually attract, those of the former mutually repel, each other. Hence the appearing divergency in a stream of electrified effluvia.

4. But, though the particles of electrical matter do repel each other, they are strongly attracted by all other matter.

5. From these three things, the extreme subtilty of the electrical matter, the mutual repulsion of its parts, and the strong attraction between them and other matter, arises this effect, that when a quantity of electrical matter is applied to a mass of common matter of any bigness or length, within our observation (which hath not already got its quantity), it is immediately and equally diffused through the whole.

6. This common matter is a kind of sponge to the electrical fluid. And as a sponge would receive no water, if the parts of water were not smaller than the pores of the sponge; and even then but slowly, if there were not a mutual attraction between those parts and the parts of the sponge; and would still imbibe it faster, if the mutual attraction among the parts of the water did not impede, some force being required to separate them; and fastest if, instead of attraction, there were a mutual repulsion among those parts, which act in conjunction with the attraction of the sponge; so is the case between the electrical and common matter.

7. But in common matter there is (generally) as much of the electrical as it will contain within its substance. If more is added it lies without upon the surface, and forms what we call an electrical atmosphere; and then the body is said to be electrified.

8. It is supposed that all kinds of common matter do not attract and retain the electrical with equal strength and force, for reasons to be given hereafter.

And that those called electrics, *per se*, as glass, etc., attract and retain it strongest, and contain the greatest quantity.

9. We know that the electrical fluid is *in* common matter, because we can pump it *out* by the globe or tube. We know that common matter has near as much as it can contain, because when we add a little more to any portion of it, the additional quantity does not enter, but forms an electrical atmosphere.

And we know that common matter has not (generally) more than it can contain, otherwise all loose portions of it would repel each other, as they constantly do when they have electric atmospheres.

Some such fluid or materialistic theory to account for the nature and effects of electricity is what a natural philosopher of Franklin's day would most naturally have adopted. Effluvia, subtile fluids or ethers were the agencies generally imagined to account for the phenomena of heat and magnetism, and electricity was from ancient times supposed to be some kind of a material thing. The merit and force of Franklin's conjectures lay in their simplicity and in the clear and satisfactory manner in which he used them to explain nearly all the electrical phenomena which had been observed in his day. The test and merit of any theory is its utility to coordinate a large class of phenomena and to prophesy other like phenomena which will occur under certain conditions.

For explaining the electrical effects known in the eighteenth century, Franklin's one-fluid theory was nearly irrefragible. He himself, however, made one experiment which he was unable to explain and which, if he had considered it more deeply, would not only have led him to further important discoveries but would have cast much doubt upon his hypotheses. This experiment was as follows:

A cork suspended on a silk cord was electrified, and, being held by the silk, was lowered into the interior of a tin vessel setting on wax. The cork was found not to be attracted to the inside surface of the vessel. He next found that if the cork was allowed to touch the inside of the tin vessel, and was then removed from the vessel, it lost *all* its charge. Of course, according to his theory, the tin vessel in the first case should have attracted the cork when held near the tin inside as well as outside, and in the second case, the surplus electric matter should have proportionately attached itself to the tin, and the cork not have lost *all* its charge.

Franklin, in common with all investigators of electrical phenomena, felt the necessity of employing some kind of symbolism in order to picture mentally the electrical effects and processes that take place; processes which are so out of accord with ordinary experiences.

His symbol for an electric charge was fluid, superabundance of the fluid being pictured for a positive charge, deficiency of fluid for a negative charge. He pictured the electric field as an atmosphere of this fluid surrounding the charged body. He made this electric atmosphere actually visible by causing smoke from burning pitch to rise around a charged body. In still air the smoke took the form of the electric atmosphere, rendering it visible. What Faraday's lines of force were to him, a material fluid was to Franklin. In some of his conjectures Franklin seems also to have nearly formed the more modern conception of a charge being merely a state of stress in the dielectric. Thus, in 1748, he writes:

"When a bottle is charged in the common way, its *inside* and *outside* surfaces stand ready, the one to give fire by the hook, the other to receive it by the coating. . . . So a straight spring (though the comparison does not agree in every particular) when forcibly bent must to restore itself contract that side which in the bending was extended, and extend that which was contracted. . . . Thus, the whole force in the bottle and of giving a shock is in the glass itself; the non-electrics in contact with the two surfaces seeming only to *give* and *receive* to and from the several parts of the glass." Here, as previously suggested, he seems to think of the electric matter as being trapped in the pores of the glass and the charged condition to consist of a forcible displacement of the entrapped fluid from one side of the glass towards the other.

Can we say to-day that the state of strain set up in a dielectric under the influence of a difference of potential is not some such displacement of an actual material substance which we call electricity?

Though Franklin's theory may contain some elements of truth, the discoveries made in the next generation made it prac-

tically certain that it was insufficient, to say the least, to explain even the greater number of the new facts discovered. Yet the electrical phenomena known in 1750 could all be accounted for and new phenomena of the same class foretold by Franklin's one-fluid conception of electricity. The question is naturally asked, though our modern electrical theories attempt with apparent success to explain all the phenomena known *to-day*, may not the close of the twentieth century record new discoveries in electricity which will be as little capable of explanation by these present theories as the known facts of to-day are incapable of explanation by Franklin's hypotheses? Doubtless, it will be thus. Theories die but facts survive.

Nevertheless, though Franklin's theory of electricity may now seem obsolete, it had a strong influence on the development of the then youthful science.

His ideas of the flow of an actual fluid through conducting matter have so permeated electrical thought and influenced the language that those better informed find it impossible to escape from the influence of these ideas.

Franklin's chief contributions to electrical science, which were made principally between the years 1747 and 1752, may be summarized as follows:

1. The notable effects of points in dissipating an electric charge.

2. The first clear appreciation of the distinction between two kinds of electric charge, the positive and negative.

3. The discovery of the distinction between conductors and non-conductors of electricity, and the coining of these terms.

4. The discovery that the real seat of the charge in a condenser lies in the dielectric.

5. The discovery that different materials when rubbed produce some a positive and some a negative charge.

6. The identity of lightning with electricity.

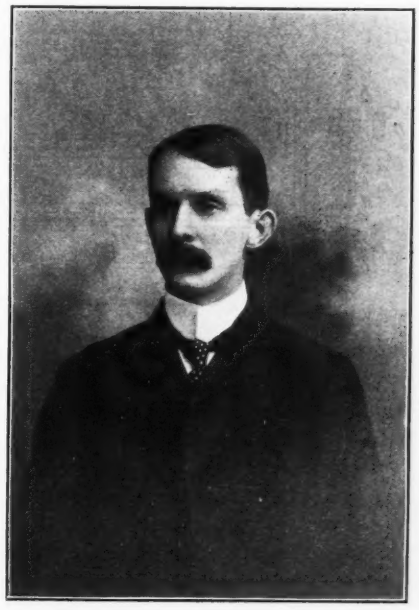
7. The invention of the lightning rod.

The career of Franklin, from whatever side we view it, is alike remarkable. He was a man of universal interests, yet profound in everything he touched. In the strict sense of the word he was not a literary man, most of his writings being contributions on topics of the day or letters of instruction or entertainment written to friends. But the humorous and philosophic touch which his pen gave to every subject, together with the fund of good sense shown in every matter, makes his writings well worth perusal to-day.

We have attempted to show how much he accomplished as a scientist in electricity, but his attention was not confined to this branch of science by any means. He made numerous practical inventions and ably discussed nearly every branch of natural philosophy. Bold thinker that he was he could not accept Newton's theory of light, which it was in his day heresy to disavow. He believed, and gave many cogent reasons for his belief, that light was a vibration in a universal medium. He correctly explained the St. Elmo's fires, the action of oil on water in smoothing it, many meteorological phenomena, and made, with the means known in his day, a quite extensive study of the electrification of the clouds.

His writings on natural philosophy, and especially on electricity, may be read with extreme interest and profit. If students of electricity would study the subject more in its historical developments than in common, their ideas of the subject would be greatly enriched and electrical science would be found to lose much of the severe and almost forbidding formal and mathematical character which too many find it to have. To one who familiarizes himself with the perplexing questions which arose in the minds of the great discoverers of electrical science, electricity will not be felt to be the dry and settled and almost exhausted subject that many students of modern text-books feel it to be.

The reader agreeing with these views can not do better than to begin with the study of electricity as set forth by our first great electrician, Benjamin Franklin. Consult the complete works of Benjamin Franklin, Vol. II, compiled and edited by John Biglow.



FREDERICK INNESS ALLEN.
The Newly Appointed Commissioner of Patents.

Mr. Frederick I. Allen, the New Commissioner of Patents.

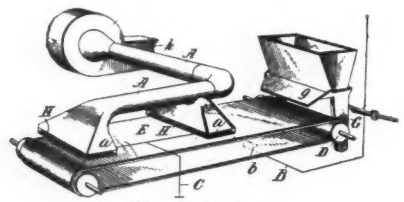
In the appointment of Mr. Frederick I. Allen, of Auburn, N. Y., as Commissioner of Patents to succeed the Hon. Charles H. Duell, President McKinley has made an especially fortunate selection. Mr. Allen has been a life-long student of patent law, was born into the business and is himself a natural mechanic and inventor. He, however, has always taken the position that he should not himself be interested as a patentee and therefore has been free to devote himself unhampered to the pursuit of the highest standards in his profession. A matter which has caused some newspaper comment is the fact that Mr. Allen has been a director in the Empire State Telephone and Telegraph Company, of Auburn, N. Y., a licensee of the American Bell Telephone Company. The ELECTRICAL REVIEW learns that Mr. Allen's conduct in this matter has been in line with his high character in all his professional dealings. The facts in the case are that some years ago Mr. Allen invested in the local telephone company in Auburn some bonds. Before qualifying as Commissioner of Patents he disposed of these holdings at a sacrifice and resigned his position as a director of the company.

Mr. Allen was born at Auburn, N. Y., on January 19, 1859. His father, William Allen, who died about 20 years ago, was a well-known patent attorney, a leader in his profession and associated at various times with such men as Seward, Blatchford, Harding and Gifford. He was prominently identified, among other important cases, with the litigation over the earlier inventions relating to mowers and reapers.

Frederick I. Allen was graduated at Yale University, where he took a high stand in the Sheffield Scientific School, in the class of 1879. He was admitted to the bar in New York State in 1882. Since then he has been in the active practice in his profession, making patent law a specialty and having a practical monopoly of that class of law business at Auburn. He has met with remarkable success in his litigated cases. Mr. Allen is regarded as one of the best-informed men on scientific and technical subjects in this part of the country. The endorsements which he secured from the judges of the United States courts, the judges of the Supreme Court of New York State and, without exception, from his fellow members of the bar eminently testify to his fitness for the position to which he has just been appointed.

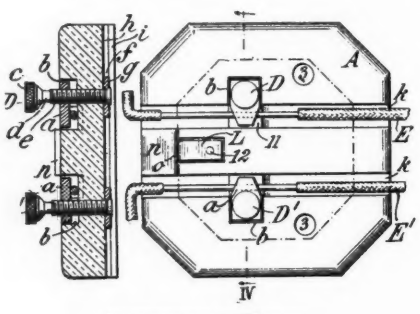
Recent Electrical Patents

Inventors have recently been devoting considerable time to the separation of magnetic ore by means of static electricity, the particles being electrified and thus separated from the non-metallic residue. Difficulty, however, has been experienced in controlling the electrified particles, as they not only mutually repel each other but are alternately attracted to and repelled by any solid substance used to effect separation of the metallic from the non-metallic particles, and the result is a general scattering of the metallic ore without an effective separation. It has also been common to use an air-blast to effect a mechanical agitation of the ore, but by this method the smaller particles of the valuable metallic substances are either blown away or are mixed with the non-metallic particles, so that a thorough concentration can not be effected. Henry M. Sutton and Walter W. Steele, residents of Dallas, Tex., have recently obtained patents on a machine and a process which they claim will overcome the above objections. Broadly stated, the machine consists of an electrified surface upon which the ore is placed, a screening device capable of electrical repulsive action, disposed adjacent thereto, and means for conducting non-metallic particles through the screen. In the construction they describe, an endless belt is provided which is arranged to be electrified, and suitable means are employed for spreading the material in a thin layer upon the belt. Located over the belt is an air-conducting tube, provided with inlet nozzles arranged adjacent to the upper surface of the belt, suitable means being provided at the other end for creating air suction. Screens are located between the nozzles and the belt, and are so connected with a suitable source of energy that they will maintain an electric repulsive action. The result will be obvious; as the material passes beneath the nozzles, the electrified particles will adhere to the belt, while the non-metallic particles will be drawn up from the air-blast through the screen and into the conducting pipe. At the same time, should any metallic particles be so comingled with the non-metallic portion, they will be repelled in passing through the screen and again drop upon the belt.



ORE SEPARATOR.

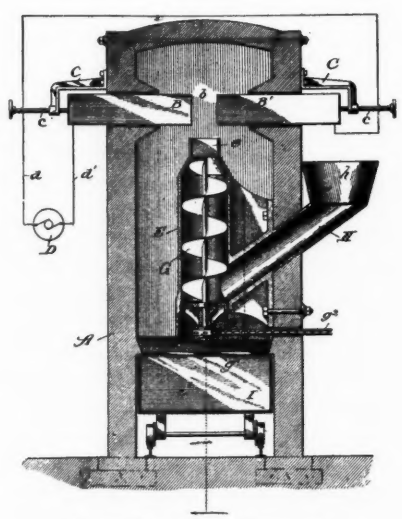
A very broad patent has been obtained by John S. Schenck, of Brooklyn, N. Y., on an electrical connection which may be employed for connecting incandescent lamps into a circuit, or in any other analogous relation. The device is made of three sections or elements. First, the base, which is arranged to be suitably secured, and has binding-posts that are connected to the line wires. The second element is what may be termed a main or outer casing, secured to the base and having a pair of binding-posts, to which are fastened the terminals of the loop or branch circuit. These binding-posts are, however, entirely insulated from those of the line wires. The third element is a combined fuse block and switch, having binding-posts which are so arranged that a fuse wire can be readily secured thereto. This device is slipped into the outer casing and connects the line-wire posts with those of the loop, thus completing the circuit. The advantage of this construction will be apparent, for in case the fuse is blown it is only necessary to withdraw the block and remove it to a place where it is most convenient to replace the fuse. All danger of short-circuiting is thus obviated.



CONNECTING-IN DEVICE.

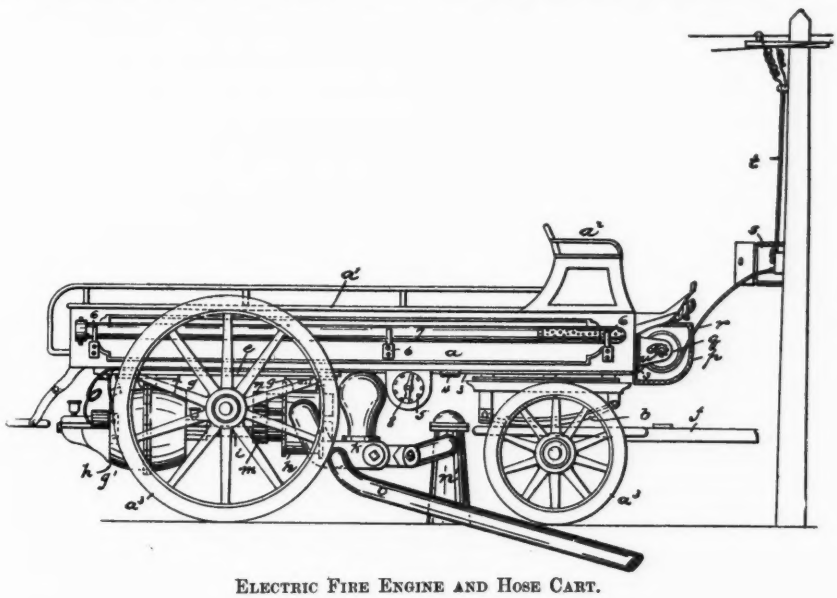
A new electrical furnace for producing calcium carbide has been patented and embodies a feature of great importance, in that the metal is fed to the arc from beneath the same, thus ensuring a proper contact and thorough treatment. The mechanism employed is substantially as shown in the accompanying illustration. The usual casing is provided, having the two electrodes, beneath which is mounted a vertical casing having an open upper end that is located directly beneath the space of the two electrodes. In this casing is rotatably mounted a worm conveyer, and a supply tube leads from the exterior of the furnace to the lower end of the casing. It will thus be seen that when the conveyer is rotated the material will be forced upwardly into the arc between the electrodes, and the material is thus packed securely between the same, thus using the entire heat of the arc. The resultant product drops down through the open bottom of the furnace into a car movably mounted on tracks beneath the same, this car having two compartments arranged to be alternately brought under the furnace. Thus, when one compartment is filled, it is drawn from beneath the furnace while the other one is brought into place. The result is that the furnace may be used continuously.

An exceedingly simple, if practical, electrical fire engine has been patented by Wilbur M. Whitlock and Edgar P. Harrison, residents of Newark, N. J., the idea being to construct a vehicle which carries the beam and operating mechanism therefor, and will also transport the hose. In outward appearance the vehicle resembles an ordinary wagon, having a long body in which is laid the hose. This body has suitable supports for the different paraphernalia, and steps and seats for the firemen and driver. Secured to the under face of the bottom of the body is the pump and motor therefor, which are arranged longitudinally of the vehicle and toward the rear end. The various switches and other mechanism are arranged in convenient position upon the side of the body, and a reel is secured beneath the driver's seat and carries suitable terminal wires that may be connected up to near-by feed wires in order to obtain the necessary current to run the motor.

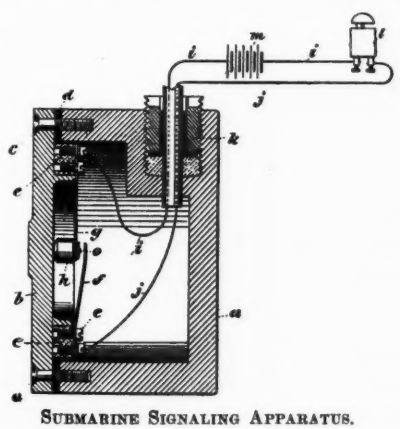


NEW ELECTRICAL FURNACE.

A German, Adolf Mensing, by name, who resides at Berlin, has recently obtained a patent in this country on a novel signaling apparatus, designed for any submarine work or in mines and similar places. The invention relates more particularly to a circuit-closer, which is completely enclosed in a water and air-tight boxing, and thus may be employed under water or in mines and other places where an explosive gas may exist which would be ignited by sparks which sometimes pass between the terminals of the circuit-closer. In the construction shown in his patent a boxing is provided having a removable cover that is secured hermetically over the open end thereof. On this cover is fastened a spring carrying at its free end a block that normally rests against the inner face of the cover. Another spring is secured at one end to the cover and has its opposite end located over, but normally spaced from, the block of the first-mentioned spring. Wires are secured to these springs and pass through an air and water-tight plug in the side of the box, being connected at their ends to a bell or other annunciator. In use it is only necessary to strike the exterior of the cover, whereupon the head carried by the spring on the inside will be thrown inwardly and against the other spring, thus closing the circuit and sounding the alarm. The device may be used for many purposes, the inventor illustrating one means which he employs for measuring the velocity of the flow of submarine currents.



ELECTRIC FIRE ENGINE AND HOSE CART.



SUBMARINE SIGNALING APPARATUS.

William F. Bossert, of Utica, N. Y., has been granted a patent on another electric switch which, like the previous ones, has been assigned to the Bossert Electric Construction Company, of Utica, N. Y. This invention relates to what is popularly known as the knife switch, but instead of providing a single knife-plate that engages between two springs, he provides a pair of spaced parallel plates pivoted at one end on opposite sides of a terminal post, and provided at its other end with a handle. The other post comprises a pair of vertically-arranged springs having their upper ends in-turned, and when the knife is brought down these springs engage between the blades thereof, and thus insure a complete and efficient contact.

International Association of Municipal Electricians.

Mr. Morris Mead, of Pittsburgh, Pa., president of the International Association of Municipal Electricians, has called a meeting of the executive committee of that body, to be held at Niagara Falls, N. Y., on April 27, 1901.

The Edison Storage Battery.

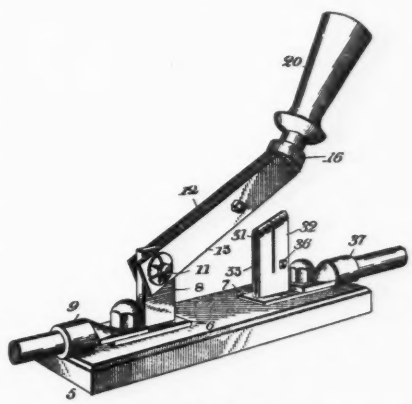
In an address delivered before the Brooklyn Institute recently, Mr. W. S. Barstow, general manager of the Edison Illuminating Company of Brooklyn, gave the following account of Mr. Edison's new storage battery:

"An improvement which will at once interest the electric engineering fraternity as well as the public, will be in the line of storage batteries. The present storage battery, although superior to that of several years ago, is still a very inferior and inefficient piece of apparatus. Not only is it costly and heavy in weight, but in portable form its depreciation is rapid. Within the last few months several new types of lead batteries have been developed, although none of them has as yet been announced.

"An entire departure from the lead type of battery has recently been invented, and will soon be announced by Mr. Edison. Mr. Edison's battery contains no lead of any kind, the materials composing it are cheap, its weight is only about one-third of the present battery, and its depreciation low. Although it will be found, when a description of it is seen, that it is not what may be called a new discovery, it is, nevertheless, a successful development of what many have turned aside as useless. In fact, this is true of many of Mr. Edison's inventions. The new type of battery will be announced within the next few weeks."

The lecturer further said:

"I might go along indefinitely mentioning new developments which have taken place during the last few months. Among them would be the telpherage system, vacuum tube lighting, long-distance wireless telegraphy and many instruments of precision for measuring energy. There are phase indicators, wave tracers, power factor indicators and many other instruments which will soon find their place in the laboratory or central stations. Who can say with this encouraging start that the Twentieth Century will not be as full with electrical developments and surprises as the nineteenth?"



A NEW KNIFE SWITCH.

The National Bureau of Standards.

By George H. Draper.

When the cabinet officer leaves for the moment important public business, absents himself from cabinet meetings and makes personal sacrifices in the interest of a bill before Congress, it is construed to mean the urgent need of the passage of such a bill and the great importance such a measure is to the people of this country. This is what Hon. Lyman J. Gage, the present Secretary of the Treasury, has done in the interest of the bill for the establishment of a National Bureau of Standards. Since he conceived the idea of its importance he never has overlooked an opportunity for urging its passage by Congress.

His remarks before the Congressional Committee having the bill in charge will be of interest. They are as follows:

"MR. CHAIRMAN: We have come before the committee, as you know, to produce argument, if we can, in support of the proposition to establish what will be called the National Bureau of Standards. It will in reality be an enlargement of the present Bureau of Weights and Measures, which is now very incomplete and far behind the needs of modern scientific and commercial requirements. I am not able nor disposed to go much into the technicalities of the requirements which it is hoped this measure will meet and satisfy. In a general way, I may state that it is open to our observation that a new country is raw in its methods. It does not work by close rule. There is often a large margin for waste. In this particular of standardizing weights and measures and testing apparatus of every kind the older countries are far ahead of us. The application of a standardizing bureau, if established, will be very wide. It touches the manufacturing arts and commerce and all scientific efforts, and it will be most important in the work of education. We have come to a period where guesswork will not do, and, to use an old, familiar phrase, 'pretty near' does not count. Exactness and absolute conformity to standards and uniformity are the essentials."

Since the above remarks of the secretary, the bill has become a law, and the authorization of the establishment of such a bureau in this country is a great stride in the advancement of science. Coming as it does in the very earliest days of the new century, is a most encouraging recognition of the importance of exact scientific methods as directly applied to commercial industries. It will save our great industries hundreds of thousands of dollars a year and make the researches of scientists more accurate; it will enable the surveyor to make his measurements with great precision and will give to the people means of obtaining better measures for electric light and power, gas, etc.; it will protect the government in its large contracts and will ensure the greatest care in the filling of physician's prescriptions; it will make our great buildings, our bridges and other public works stronger. By its authority, permanently accurate weights, thermometers, hydrometers, steam gauges, voltmeters, ammeters, wattmeters and other electrical measuring devices will be established. It will be the tribunal of last appeal where disputes as to the accuracy of weights and measuring instruments can be finally settled.

The cut represents the delicate "balance" used for the comparison of the smaller weights. So delicate is this balance that all manipulations are made at a distance of 15 feet, lest the heat of the human body penetrates the glass case enclosing this instrument and interferes with its equilibrium. With four brass rods turning about on their ends the weights in the balance pans are manipulated. A fixed telescope is focused from the operating ends of these handling rods upon the indicator on the balance, and thus the finest possible graduations are obtained.

It is the largest bureau added to the government for many years. The building for the laboratory, which is to be erected in or near Washington, D. C., at a cost of $250,000, will be one of the finest of its character in this country. The sum of $25,000 has been appropriated for the purchase of a site. This site will be chosen probably outside of the city limits, in order to be free from disturbing influences, mechanical or electrical, and yet near enough to be within easy communication. The preparation of the plans for the laboratory will require considerable labor, and take time, but there will be no unnecessary delay in bringing the work to completion.

Professor Samuel Wesley Stratton, of Chicago, has been appointed by the President to be director of the bureau. Professor Stratton has been the inspector of the Weights and Measures Bureau in the Coast and Geodetic Survey, having gone to Washington from the University of Chicago to accept the position temporarily, with a view of aiding the legislation which resulted in the establishment of this important scientific adjunct of the government service. He was professor of physics in the University of Chicago and has established two physical laboratories. Professor Stratton is 38 years of age and will take hold of the work immediately. He was at the head of the naval militia of Chicago and in the Spanish War served as a lieutenant in the United States Navy.

Professor Stratton is to have at the start to assist him in this most important work one physicist, one chemist, two assistant physicists or chemists, two laboratory assistants, one secretary, one clerk, one messenger, one engineer, one mechanic, one watchman and one laborer. The plan of organization of the scientific corps is to be on the basis of a few men of the highest order rather than a large number of poorly paid men, as the matters involved are questions demanding men of ability and authority to decide. The grade of physicist or chemist is to consist of men of reputation in the scientific world and specialists in some particular branch of physics or chemistry. They are to be men such as are now occupying chairs of physics and chemistry in the leading universities of the country. They will be required to perform investigations of the highest order and to direct others engaged in investigations, calibrations and tests of all kinds; to devise and select the best methods of producing and comparing standards; to keep informed as to the work and methods of the standardizing bureaus of other governments in the lines along which they are particularly interested.

The assistant physicists and chemists are to be men of considerable reputation, such as are now filling chairs of physics and chemistry in colleges, or assistant professors in the larger universities, their duties being very similar to those of their superiors.

The next or lowest grade in the scientific class is that of laboratory assistant. These men will necessarily be graduates of some recognized university or technical school, and who have done post-graduate work in the lines along which they intend to specialize. They will be selected with the greatest care and will be in direct line of promotion to all of the grades above.

The object of the new bureau, as stated by the organic act, which goes into effect on July 1 of the current year, is as follows:

"That the functions of the bureau shall consist in the custody of the standards;

the comparison of the standards used in scientific investigations, engineering, manufacturing, commerce and educational institutions, with the standards adopted or recognized by the government; the construction, when necessary, of standards, their multiples and subdivisions; the testing and calibration of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere."

Under the law these functions may be exercised for the government of the United States, or for any state or municipal government, or for any scientific society, educational institution, firm, corporation or individual within the United States, engaged in manufacturing or other pursuits requiring the use of standards or standard measuring instruments.

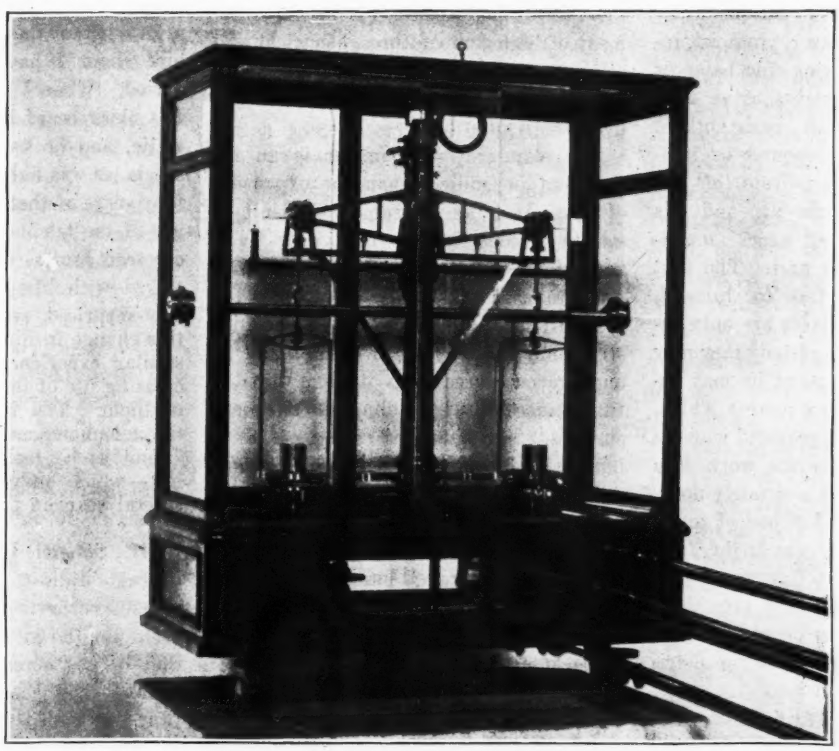
The director of the bureau shall issue from time to time bulletins containing information of value to the public. A reasonable fee will be charged for the comparisons, calibrations or tests furnished persons or firms.

The act authorizes the Secretary of the Treasury to appoint a visiting committee to consist of five men prominent in the interests involved, not in the employ of the government, to serve without compensation, who shall visit the bureau once a year and report upon its operations to the Secretary of the Treasury.

Every foreign power has such a bureau, and our work must now go abroad. Throughout our country, institutions of learning, laboratories, observatories and scientific societies are being established and are growing at a rate never equaled in the history of any nation. The work of original investigation and instruction done by these institutions requires reliable standards and measuring instruments, which in nearly every case must be procured from abroad or can not be obtained at all. The introduction of exact scientific methods into manufacturing and commercial processes involves the use of a great variety of standards of far greater accuracy than formerly required. An exact knowledge of the high temperature of a furnace or refinery or the low temperature of a refrigerating process is often essential to the working of the process. The scientific work carried on by the different departments of the government involves the use of many standards and instruments of precision, which are too frequently procured from abroad, owing to our own lack of facilities for standardizing. An institution having authority in matters pertaining to standards and measuring apparatus would serve as a means of preventing and settling many of the expensive litigations which result from inaccurate or unauthoritative standards. The necessity for such authority has in one case alone been so great that the leading association of electrical engineers has offered to provide the present office of standard weights and measures with the necessary equipment if it would undertake the work. Enormous sums are annually involved in electric light and power contracts, and yet there are no authoritative electrical standards in this country and no facilities providing for the testing of the meters and other instruments used in electrical measurements.

The electrical and magnetic properties of iron, steel, copper and other materials used in electrical apparatus and in transmission lines are factors of the utmost importance, which determine the magnitude of the various losses in the generation and distribution of electrical energy. Provision must, therefore, be made for testing instruments for determining such properties. These include standards of electrical resistance, pressure, current, capacity and self-induction, ammeters, voltmeters, wattmeters and other measuring apparatus for both direct and alternating-current systems.

Perhaps the most urgent need along these lines is for a standard measure for electric lamps. The so-called "standard candle" is an unsatisfactory contrivance with a flickery flame. To-day about one-sixth of the incandescent lamps used in this country are tested by what is known as the English parliamentary candle. This is a candle of specified composition and size which burns 120 grains an hour with what is known in England as a "government wick." It is subject to draughts and other irregularities. The National Bureau of Standards will strive for a better instrument which will be an ultimate standard.



NATIONAL BUREAU OF STANDARDS—BALANCE USED FOR COMPARISON OF SMALLER WEIGHTS.

The manufacture of physical, astronomical, chemical and other scientific apparatus has been confined almost exclusively to foreign countries, but this industry is growing in the United States at a rate which will soon place our productions equal to those of any other country. Our manufacturers of such apparatus have shown that they can compete with the foreign product in workmanship and design; they are, however, placed at a great disadvantage, owing to the fact that this government does not provide them with the necessary standardizing facilities. German and English manufacturers furnish official certificates with their apparatus, and the value of such certificates is so well recognized that we find our own manufacturers quoting prices of their apparatus which have been verified in the institutions of foreign governments. The

and maintenance. This fact has been conclusively demonstrated in Germany by the Imperial Physicotechnical Institution, established in 1887, which has been most liberally supported and which has shown remarkable results. It has been stated frequently that this institution is of far greater value to the scientific and commercial interests of this country than the provisions heretofore made by our own government.

The saving of time by the systematic testing of standards and standard measuring apparatus is no small item to be considered in estimating the value of the proposed institution. For example, every chemist, pharmacist, assayer, physicist, investigator or student using fine balances must know that his weights agree with the standard and with each other; that is to say, his unit pound or kilogramme must be a duplicate of the standard of the government, and his other weights must be exact multiples or divisions of this unit. The first fact he can never ascertain for himself, as the government standards are only accessible to those in whose custody they may be placed. The second point he may ascertain by a long, tedious process which, in the hands of an expert provided with the proper facilities, becomes the work of a few minutes and is more accurately done. The case in question is but one of many that might be cited in which the time saved by properly tested instruments is beyond comprehension to any save those who are daily obliged to devote valuable time to this purpose, much to the detriment of the real work in hand.

If the makers of scientific and other standard measuring apparatus are provided with the proper facilities for standardization, there is at once established a high standard of excellence for such apparatus and which all makers will strive to attain. If it is known by the maker that the purchaser can at any time have such apparatus verified or tested for a nominal fee, the result can be imagined even by those entirely unfamiliar with the use or construction of such apparatus.

The purity of sugar is determined by means of the polariscope, and, as the duty on sugar amounts to $60,000,000 annually and is based upon the readings of these instruments, an error of one-tenth of one per cent in these readings would cause a corresponding error of $60,000 in the duty.

In general, the hydrometer is an instrument used to determine the specific gravity of liquids. Special forms are graduated to indicate the percentage of alcohol in spirituous liquors and the revenue annually collected, amounting to $110,000,000, is based upon the readings of these instruments. Both the government and the distiller are therefore vitally interested in their accuracy. Other hydrometers are used to determine the quality of oils, acids, etc., and enter into the every-day transactions of chemists, pharmacists and manufacturers of these commodities.

These instruments now include standard thermometers used by physicists and others in exact scientific investigations, physicians' thermometers, pyrometers or the various instruments for the measurement of high temperatures, electrical and other thermometers for the measurement of low temperatures and devices for temperature regulation.

The standard thermometer is an instrument depending upon the expansion of gas. It is an instrument difficult to set and which can be used only by a trained scientist. It is rarely in practice used to measure temperature, but the graduations of all the above-mentioned instruments are determined by means of it, and are compared with it from time to time, since they are subject to frequent changes. The Kew Observatory, of England, standardized 17,962 clinical thermometers in the year 1897. In the same year the German Government tested 16,329 thermometers at the Reichsanstalt and 100,000 at the branch bureaus.

Protest Against Laying Manila Cable Overruled.

The Eastern Extension Company, which controls the cable running from Hong Kong, China, to Manila, P. I., some time ago protested against the laying of United States cables in the Philippine Islands to connect with Manila, as under the Spanish régime the privilege was granted to the company of exclusive rights in cable construction. The permission was accompanied by but one reservation, which stated that the Spanish Government had the right to lay cables for state purposes.

The United States cable-ship Burnside is to continue laying cables for the War Department, the United States courts having decided that the cable in process of construction is for state purposes, and that the Spanish concession is not violated thereby. The grant made to the cable company was put into effect immediately prior to the Spanish-American War, and extends over a period of 40 years.

Views, News and Interviews

"I was startled the other day, and in an entirely new way," said a prominent electrical engineer to a REVIEW man. "The use of the telephone has become so much a part of my life that in talking with my friends and acquaintances every few days, I apparently kept up the acquaintance as of old when I used to see them more regularly. A few days ago I had occasion to visit an old-time friend of mine with whom I had talked probably once a week or oftener for the past three or four years, but whom I had not seen during that period. When I met him I was startled. His black beard had turned gray, almost white, and he had changed in other respects, as was natural during the three or four years of that period, yet through the use of the telephone I had in my mind's eye seen him as of old every time I had talked with him, and you may imagine how surprised, even shocked, I was to see this change in him. Did you ever have a similar experience? I imagine the increasing use of the telephone causes many of them. You hear the usual voice on the telephone and mentally picture the friend as he looked when you saw him last—which may have been a year or several years in the past."

Mr. Samuel Insull, president of the Chicago Edison Company, has been a recent visitor to New York city looking after the large manufacturing interests that he has here. Mr. Insull was president of the Electric Cab Company, of Chicago, which decided to retire from business, and states that the only reason for this was that the company did not find Chicago a profitable field of operation. Mr. Insull is one of the most active of the electrical men of the day and since coming to this country some 20 years ago, at first being associated for a long period with Mr. Edison, has amassed a fortune through his able management of electrical properties.

The Park Row Building, 13-21 Park Row, New York, has been transferred from the Park Row Construction Company to the Park Row Realty Company. The revenue stamps on the certificate indicate a consideration of $4,100,000. This building, which is occupied by a large number of electrical engineers and electrical firms and companies, among them being the ELECTRICAL REVIEW, is the tallest structure in New York and has the honor of having more offices and greater floor space than any other building of its kind in the world.

PIONEER POWER DEVELOPMENT AT NIAGARA FALLS.

BY ORRIN E. DUNLAP.

The earliest power development known to have been made at Niagara Falls was in 1759, when a small sawmill was built on the mainland opposite Goat Island by a party of French settlers. They were the pioneers in an industry which has grown to proportions unequaled at any other spot in the world. While it is highly probable that small amounts of power were utilized from that time on during succeeding years, there is no record of a substantial plan for the development of the river's force being made public until about the year 1840, when General Peter B. Porter and Augustus Porter devised a practical plan whereby man might avail himself of a portion of the river's energy. In 1847 this plan was made public through a circular, and in general the plan outlined was very similar to that now used by the Niagara Falls Hydraulic Power and Manufacturing Company.

This company's central station is located at the water's edge down in the gorge, and will be one of the interesting places for visitors to the Pan-American Exposition to inspect the marvelous development of power at Niagara Falls. The water for the development of power is taken from the upper Niagara River nearly a mile above the Falls, and is conducted through an open canal through the heart of the city to the edge of the high bank of the lower river. This canal has a width of from 70 to 100 feet, while its depth is from 10 to 14 feet. The water that flows through the canal passes to a basin 300 feet back from the edge of the high bank. From this point it flows through two connecting canals to a forebay at the edge of the bank. It then enters penstocks, three in number, and plunges down to the turbines in the power-house 200 feet below. One of the penstocks of this plant has a diameter of eight feet, while the other two are 11 feet in diameter, made of flange steel. One of these penstocks hugs the cliff in its descent to the power station, while the other two stand out in column form.

The power-house at the water's edge is a stone building, 60 by 180 feet in dimensions. It is built of stone excavated on the site, and in it is one of the cleverest installations to be seen at the Falls. When Pan-American visitors inspect it, it will contain 14 turbines of from 2,000 to 3,000 horse-power each. They are mounted on horizontal axes with electric generators coupled to each end. Visitors to this power-house are much impressed by the fact that all parts of the wonderful installation are in plain view. They can see the canal that conducts the water from the river, and they look upon the great penstocks that carry it from the forebay to the turbines. Down in the power-house all of the turbines and generators are on one floor in full view, and there is nothing left for the visitor to imagine. The head under which the wheels are operated is 210 feet, which is exceedingly high.

The Niagara Falls Hydraulic Power and Manufacturing Company acquired possession of the property in 1877, but at that time it was not considered that a head of water such as that in use in the station to-day could be utilized. However, in the eighties hydraulic engineering made great strides, and makers of water-wheels began to understand that there was a growing demand for more efficient apparatus. Water-wheels to withstand the awful pressure of Niagara's waters were needed. In 1892 a head of 120 feet was utilized on the company's property, and in 1895 the present generating station was begun. The first section was completed with rapidity, and the second section was built. Now the third section, completing the plans for the station, has been finished. That this should have occurred in time for the inspection of visitors to the Pan-American Exposition is a piece of rare good luck, especially so when it is considered that the first great power-house of the Niagara Falls Power Company has also had its installation completed.

On the lands of the Niagara Falls Hydraulic Power and Manufacturing Company there are numerous industries utilizing the electrical, mechanical and hydraulic power, and the majority of them receive visitors. The mechanical power developed by this company is 360 horse-power, the hydraulic power is 7,000 horse-power, while the electric power is 19,037 horse-power. Much of this electric force is transmitted to the top of the high bank and applied to the manufacture of aluminum, chlorate of potash, bleaching powder and caustic soda in various factories there located.

Of the industrial features of Niagara Falls, the power-house of the Niagara Falls Hydraulic Power and Manufacturing Company is one of the most important.

New York Electrical Society.

The New York Electrical Society will hold its next meeting at Havemeyer Hall, Columbia University, Thursday, April 25. Mr. C. F. Scott, chief electrician of the Westinghouse Electric and Manufacturing Company, will lecture on alternating-current motors.

Cables for the New East River Bridge, New York.

On April 7 the John A. Roebling's Sons Company took the first important step in the making and laying of the cables for the new East River Bridge at New York. The contract was awarded to the company several months ago and the preparation of plans and other preliminary work, as well as the main part of the contract which is to follow, is under the supervision of Mr. Charles G. Roebling, the president of the company, who is assisted by Mr. William Hildenbrand. The work done was the placing in position of the two and one-fourth-inch diameter ropes which support the temporary footbridge on which the workmen will stand during the main work of cable-laying. Several methods of getting the first line across have been employed in the past, and kites, swimmers and other agents have been tried, but the method employed on this occasion is thought never to have been tried before, and is a distinct advance over all previous ones. The method adopted was to carry the drum containing the cable across the river on a float (one end having previously been secured) and pay out the cable, allowing it to rest on the river-bed until at the proper time it could be raised from the water and brought to the desired height by means of a stationary engine and drum. The first cable was successfully raised on April 11, the time required being only seven minutes, navigation being, of course, suspended during that period. The remaining cables, which were strung this week, were raised on succeeding days in a similar manner, there being little or no inconvenience to the shipping in the river. Mr. Roebling believes that both laying and raising of the cables were accomplished in record time.

Bequest to Armour Institute.

Mr. J. Ogden Armour, on April 10, is reported to have announced to the Rev. Frank W. Gunsaulus, D. D., the president of Armour Institute, of Chicago, Ill., that he and his mother intended to give the Institute $1,000,000. Armour Institute was founded by the late P. D. Armour with an endowment of $2,500,000, but when Mr. Armour died no further provision was made for the school, and Mr. J. O. Armour's present gift of $1,000,000 will in all probability be used to extend the scope of the school in the fields of electrical and mechanical engineering. There is stated to be no truth in the rumor that the Institute is to be absorbed by the University of Chicago.

Electric Railways

An electric railroad will soon be built in Vermont, between St. Albans and Swanton, and from that city to St. Albans Bay, about 12 miles in length. It is expected to be in operation by July 1.

The Chattanooga, Tenn., Electric Railway Company recently paid off $250,000 of its bonded indebtedness, which is taken to mean the consolidation of its lines with that of the Rapid Transit Company, of Chattanooga.

The recently incorporated Ellenville & Kingston Railroad Company, of New York, will build a standard-gauge road 28 miles long to connect with the Ellenville branch of the New York, Ontario & Western steam lines, and will operate the system by electricity.

Mr. A. L. Johnson is agitating three-cent street car-fares in Cleveland, Ohio, and he and Mr. Martin Mullen, of that city, are reported to be interesting eastern capitalists in the proposition, their idea being to ask for franchises to parallel the existing lines of electric street railways throughout the city.

The North Jersey Street Railway Company and the United Electric Railway Company will probably consolidate. The North Jersey is a consolidation of all the street railroad companies in Essex, Hudson and the adjoining counties, while the United controls all the electric lighting and power companies in the same territory and beyond.

Current rumors in Cape May, N. J., state that the Philadelphia & Reading Railroad Company has a corps of surveyors at work there surveying for the projected beach trolley line, which will run along the Delaware Bay side of the county from the Cape May court-house to Cape May Point, connecting there with the beach front trolley. When completed the road will be about 10 miles long.

It was decided by the directors of the Bergen, N. J., Turnpike Company at a recent meeting to accept the franchise offered by the towns of West Hoboken and Union Hill, and the townships of North Bergen, Fairview and Ridgewood Park, for the establishment of a new electric trolley line between Hoboken and Hackensack. The directors also decided to raise $1,000,000 with which to build the road.

Plans are being made in Ottumwa, Iowa, to convert the abandoned Chicago, Burlington & Quincy tracks between Ottumwa and Agency City into an electric line, over which cars will be run every 30 minutes. The plan now is to use the old Fort Madison tracks from Sugar Creek to the old depot and make connection from there to Main street with the city electric lines. By doing this the only part of the road to be constructed will be about a block in length, which is necessary to connect the two.

A franchise has been asked of the city councils of Deadwood, Lead and Spearfish, S. D., to permit a company, which will soon be formed, to build an electric railway through the streets of these three towns. Altogether the road will cost about $400,000, and the Deadwood promoters have received sufficient guarantees from Chicago and New York capitalists to build and equip the line, which, when complete, will give a railway service to Pluma, Terraville and Central City from the three towns named.

The recently incorporated Genesee, N. Y., & Orleans Railway Company, which was chartered a few days ago for $350,000, will build an electric surface railroad 27 miles long, from Batavia to Point Breeze. The directors of the new company are George W. Aldridge, John H. Gregory, Houston Barnard, George Wilder, Frederic P. Allen, Charles H. Babcock and John F. Kinney, of Rochester; Charles E. Hart, of Albion, and James M. Aiken, of Barre, Orleans County. The principal office of the company will be at Albion.

The recently incorporated Philadelphia, Trenton & New York Railroad Company (electric) will be built as soon as the weather permits, part of the road being already mapped out. From the terminus of the Trenton, Lawrenceville & Princeton Railroad Company, already constructed, to the New Jersey side of the Calhoun street bridge across the Delaware, is about a mile, and the company expects to begin work on that section within a very short time, running over the bridge into Philadelphia. The directors of the company include Messrs. Gardner H. King and L. C. Case, of Trenton.

A franchise was recently granted by the county commissioners of Union County, Ohio, to the Union Electric Railway Company to operate three electric railroad lines along certain pikes in that county. The board of directors of the company includes Messrs. C. M. Buchanan, of Pittsburgh, Pa., who is also president, and Mr. Thomas M. Kerr, of Columbus, who is treasurer of the company. The three lines will aggregate 53 miles in length and their estimated cost is over one million dollars. The power-house and car barns alone are to cost $75,000.

After the plans of the capitalists who are back of the projected electric railway from New York to Pittsfield, Mass., are successfully carried out, direct trolley communication will be had between the two cities, a distance of 175 miles. Several New Yorkers are said to be interested in the project, and the proposed route has been already surveyed. Starting at Ashley Falls, Mass., where it will connect with the lines of the recently organized Berkshire Electric Street Railway Company, the road will go through Norfolk, Goshen, Litchfield, Bantam Lake, Morris, Bethlehem, Woodbury, Southburg, Monroe and Huntington to Bridgeport, and thence to New York.

A bill was recently introduced into the state legislature at Albany, N. Y., by Assemblyman Lynn, relating to an amendment of the railroad law regarding the acquisition of property by street surface railroads. The bill is said to take out of the present law the provision which prevents surface railroads from acquiring the property by condemnation, and is designed to place surface roads on an equality with steam lines. Mr. Lynn is said to have stated that there are a number of places in the state where the electric roads could compete with steam lines and bring down the rate of transportation if they had the right of condemnation proceedings which the steam roads possess. The bill was hotly contested at both its first and second reading, and is meeting with such opposition that its passage is regarded as somewhat doubtful.

Capitalists in Alton, Ill., are said to be projecting an electric railway from that city to St. Louis, Mo., and negotiations are now in progress for constructing an electric railway from Alton to Granite City. Connections will be made from there with the street railway that runs from East St. Louis to Granite City, and President Porter, of the Alton Railway, Gas and Electric Company, recently stated that the new electric line will probably be built before the opening of the St. Louis Fair, in 1903. The financiers who are interested are the same men who financed the Alton Railway, Gas and Electric Company, which owns the street railways, electric lighting, gas and hot-water heating systems in that city and the suburbs, and whose investments in the past five years in Alton have aggregated about $700,000.

Electric Lighting

A new power-house will be erected in the near future at Waterbury, Ct., by the Connecticut Electric Lighting and Power Company.

A bond issue to the amount of $500,000 will be made soon by the Dayton, Ohio, Electric Light Company to provide for improvements to its plant.

The city of Harbor Springs, Mich., has recently decided to install an electric lighting plant at a cost of about $10,000. Particulars may be had of the city clerk.

A municipal electric lighting plant is to be erected in Sellersville, Pa., at a cost of about $12,000. The plant when completed will be owned by the municipality.

An ordinance has been introduced recently into the common council of Columbus, Ohio, to provide for a bond issue of $132,000 for a municipal electric lighting plant.

A franchise has been applied for in Saugerties, N. Y., by the Saugerties Lighting Company, which has asked the common council for its permission to erect a plant.

Reports from Boston, Mass., state that the Cambridge Electric Light Company is soon to erect a new power-house at Western avenue and Blackstone street to develop about 10,000 horse-power at a cost of about $250,000.

Messrs. J. S. Bartlett and Walter Abbott, both of Boston, Mass., and S. S. Streeter, of Concord, N. H., are said to have purchased the plant of the Concord Land and Water Power Company with a view to maintaining an electric lighting system.

One of the two bills recently drawn by the city attorney of Bristol, Tenn., and which will be presented to the state legislature at its next session provides for a $25,000 bond issue, to be applied to the construction and equipment of an electric lighting plant to be owned by the city.

Reports from San Josè, Cal., state that it is likely that the common council will be asked at its next sitting to increase the electric lighting estimate for the city from $50,000 to $65,000. The first estimate was but roughly figured and the new one is based upon careful calculations by thoroughly practical men.

A contract has been closed recently by the Oakland, Cal., Gas, Light and Heat Company with the Bay County Power Company, by which the former concern gets control of all the electric lighting and power in Alameda County. The Oakland company already has a contract with the Standard Electric Company, under which the latter now operates.

Bids will be considered until about May 1 for the erection of a plant with a capacity of 50 2,000-candle-power arc and 2,000 16-candle-power incandescent lamps by the Frenchtown, N. J., Electric Construction and Maintenance Company. The bids must fall within $15,000 and the company's engineer who will receive them is John Hyde, Jr., of Trenton, N. J.

Reports from Knoxville, Tenn., state that the Knoxville Power Company has been granted permission to throw a dam across the Little Tennessee River, and to build a transmission line from Knoxville to Sevierville—a distance of about 20 miles—for lighting the two cities. The cost of the work will be in the neighborhood of $800,000, and it is stated that ex-Congressman J. C. Honk is interested.

By a consolidation of all the principal electric and gas lighting and heating interests in the city of Montreal, Canada, a corporation was formed on April 4 which will be known as the Montreal Light, Heat and Power Company. The new company will have a capital stock of $17,000,000 and is expected to absorb the Montreal Gas Company, Chambly Manufacturing Company and the Royal Electric Company.

The combination of the Cincinnati, Ohio, electric lighting companies, is said now to be assured, as the directors of the various companies interested have accepted the offer of terms made by the North American Company. The companies concerned in the transaction and the percentages which the arbitrators are: Cincinnati Gas Light and Coke Company, 68.80; the Cincinnati Edison Electric Company, 27.65; the Jones Brothers Electric Company, 3.20; the Brush Electric Light Company, .05; the First Cincinnati Edison Electric Company, .30; total, 100. In money, the values of the percentages are Cincinnati Gas Company, $19,264,000; Cincinnati Edison Company, $7,742,000; Jones Brothers Company, $896,000; Brush Electric Company, $14,000; First Cincinnati Edison Company, $84,000; total, $28,000,000. The total capital of the new organization will be $28,000,000, and several extensions to increase the business are proposed.

Automobiles

One cow, two dogs, three sheep, 16 pigs and 23 chickens were killed, and a stone wall and hay cart seriously damaged in the recent automobile race from Berlin, Germany, to Aix-la-Chapelle.

An automobile contemporary states that "G. H. Lockwood, a peripatetic Socialist, has a project for acquiring a specially designed motor wagon to assist him in spreading his gospel. Besides cooking and sleeping apartments for the evangelist himself, it will carry a graphophone and other specialties."

A new automobile club has come into existence in Massachusetts, and is known as the Automobile Club of New England. Its headquarters have been established at the house formerly used by the Suburban Club at Brookline, and the stable which was formerly devoted to the horses and rigs of the members of the old club affords a convenient storage for the automobiles, and a skilled mechanic in attendance has been retained to look after the necessary repairs.

Automobiles are to be employed by the United States Post Office Department in transferring mails from the Federal Building in Buffalo to the Pan-American Exposition grounds, and proposals have been asked for on the following terms: The distance is 4.25 miles. Not less than five nor more than seven round trips are to be made each day, the vehicles running according to schedule between 4 A. M. and 11 P. M., the running time for each trip each way being not over 35 minutes, exclusive of loading and unloading. Each machine must have a capacity of 800 pounds of mail matter. The service will begin on April 15 and continue until November 15, the department reserving the right to discontinue the service before November 15 if such a step is considered advisable.

Press despatches from Managua, Nicarauga, state that the United States consular agent at Matagalpa, Mr. Isaac Manning, has, with Messrs. W. H. de Lavigney and William Delany, owners of large coffee estates, obtained large concessions from the Nicaraguan Government to the Compania de Transportes de Matagalpa, for the purpose of operating a train of freight cars loaded with coffee by an automobile. The gentlemen are attempting to get the Nicaraguan Government to give them $20,000 in installments.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

(Continued from page 483.)

Each rib is made independent by tying the ends with the main cross-bars, and not depending on any centre conductor or support, thus giving a low internal resistance.

Mr. M. R. Hutchison:

Akouphone and akoulalion — Microtelephonic instruments so constructed as to reproduce and intensify sounds and still preserve their quality.

Professor S. P. Langley:

Bolometer drawings and diagrams showing construction and principles employed, Smithsonian reports of astrophysical observatory, photos and large map of solar spectrum. Two large pictures of Aërodrome.

Professor Frank A. Laws:

Radiographs of alternating-current wave forms and oscillatory discharges—These radiographs were made by the use of cathode ray tubes of the Braun pattern.

Mr. Otto T. Lewis:

1. Electric furnace—The furnace consists of several terra-cotta cylinders about two inches in diameter and one-half inch thick, around which is wound platinum wire of 22 B. & S. gauge. The wire is put on in four circuits, so that as the resistance increases with the heat, the circuits may be thrown from series to parallel. The cylinders have longitudinal and vertical motions, and are held in position by clamps.

2. Ohmmeter—An instrument for making direct measurements of electrical resistances, from 10,000 to 10,000,000 ohms.

3. Fifty-five-centimetre Wimshurst influence machine—This is shown with Professor Ryan's apparatus, in Room 510, third floor.

Mr. Herbert Lloyd:

Cells of a special form of chloride accumulator designed for traction purposes as used on the Thirty-fourth street cross-town line, New York city. Oxide cells for vehicle purposes. Specimen plates were shown.

Mr. H. R. Palmer:

Fac-simile picture telegraph in operation—A system whereby half-tone pictures, sketches, handwriting, etc., can be transmitted over long distances, employing ordinary telegraph circuits. The original picture is enlarged for the purpose of transmission and when received is photographically reduced to its normal size, thus giving an exact reproduction of the original. The enlargement is for the purpose of obtaining a greater contact surface for the transmitting stylus.

Messrs. Frank Perret, J. A. Barrett and W. H. Meadowcroft:

Storage battery made on a unit system, whereby cells of different sizes are built up of universal units of definite capacity. Purely Plante formation. No oxidizing agents are used and nothing but pure lead sulphuric acid and water are employed for the process of construction.

Dr. Michael I. Pupin:

Original apparatus used in developing the recent invention for the improvement of long-distance land and ocean telephony, consisting in the location of inductance coils in the line at distances which are definite small fractions of a current-wave length.

Colonel Samuel Reber, U. S. A.:

1. Wireless telegraphy in operation, employing methods and improvements as worked out for the use of the United States Government.

2. United States Army field telephone and telegraph kit used in the Cuban and Philippine campaigns.

Mr. L. T. Robinson:

Wave-form indicator—An instrument consisting of a small synchronous motor in connection with suitable commutating devices used for determining the wave shapes of alternating current.

Mr. Martin Rice:

New X-ray apparatus, employing a modified form of Wehnelt interrupter.

Professor Harris J. Ryan and Professor J. O. Phelon:

Radiographing of alternating-current waves—A method for securing stationary and continuous diagrams or cards of alternating-current values, which are conveniently recorded by means of a simple form of pantagraph that is run over the luminous diagram and operates a lead pencil (Wimshurst machine furnished by Mr. Otto T. Louis).

Mr. H. F. Sanville:

A copper-splicing machine—A portable and self-contained splicing press, with independent pump and flexible hose, used for making a solderless splice in wires and cables, forming a cold weld. This machine has an ability to give a pressure of 20 tons per square inch in the weld.

Mr. E. T. Schoonmaker:

A floating magnetic field—A demonstration of the field is to be given so that the particles of iron will appear to be in aerial suspension about the pole.

Mr. Elmer A. Sperry:

Types of storage battery for automobile work, with diagrams of discharge curves.

Mr. Nikola Tesla:

Some experiments with an electric oscillator. Very beautiful experiments were given before a large audience in Havemeyer Hall.

Professor Elihu Thomson:

1. Dynamo static machine—This machine contains a small direct-current motor, the windings of which are tapped and connected to two rings giving a primary alternating current for the operation of a step-up transformer which gives a secondary current of about 20,000 volts, being capable, however, of regulation, through a wide range. The tops of the alternating-current waves of high potential obtained from this secondary transformer are used to charge a number of glass plate condensers in parallel. The rotating frame synchronously driven with the motor makes the connection to the condensers periodically and in synchronism with the alternating current. The connection by the rotating frame is alternately in parallel and in series, condenser plates being charged to 15,000 volts with 10 in parallel, and giving 150,000 volts when connected in series. The machine therefore furnishes from low-pressure direct-current, high-potential discharges of definite polarity at the discharged terminals.

2. A new rotary electrical apparatus consisting of an iron sphere heavily electroplated with copper and mounted so that it may revolve on any axis or in any plane. Surrounding this sphere are three coils in planes at right angles to each other. By suitably energizing these coils with polyphase current the sphere may be made to revolve on any axis or in any direction, or it may be said to illustrate a three-dimension polyphase system. This apparatus illustrates the principles of the gyroscope and Bohnenberger sphere.

3. An illuminated disk mounted on a shaft free to rotate and having applied to it in special ways alternating-current magnetic fields, the rotations of the disk involving interesting paradoxes.

Mr. Fitzhugh Townsend:

Alternating-current wave tracer—In this device the contact is made during one-half of the period in contradistinction to the instantaneous contact method ordinarily employed.

One of the most interesting of the exhibits was that of Mr. Hewitt. He exhibited electric lighting from incandescent vapor enclosed in tubes, the light being of astonishing brilliancy and steadiness. In these lamps Mr. Hewitt has obtained efficiencies as great as from 0.5 to 0.32 watt per candle-power. The lamps consist simply of glass tubes filled with mercury vapor and having a negative electrode of mercury and a positive electrode of iron at opposite ends of the tube. For some time past Mr. Hewitt has pursued experiments looking to the production of a highly efficient light of this character and his investigations have led him to study closely the laws of vapor conductivity. Some of these laws, as he has formulated them, are exceedingly curious. For each vapor there is a density corresponding to maximum conductivity, but for each one there also holds good the extraordinary law that when they are confined in cylindrical tubes the conductivity varies as the *diameter* of the tube and not as its area. There is also a curious effect noticed in that each vapor, at a given density, seems to possess a kind of critical breakdown point of voltage, so that in

effect wide differences in current-flow may be produced with exceedingly small changes in impressed electro-motive force. Virtually this makes the vapor tube act like a conductor whose resistance varies inversely as the current flows through it. An interesting feature was the introduction of red into the spectrum of the light obtained by the use of red reflecting screens. The vapor spectrum of mercury consists of a number of lines in the yellow, greenish and blue parts of the spectrum, but there is no radiation in the red part. In consequence, the light emitted, though extremely brilliant, is of a disagreeable bluish-green color, but this effect may readily be corrected, as was demonstrated, by the introduction of reflecting screens of a deep red color, these adding the necessary element to produce a fairly normal distribution of color. One of the tubes shown was burning at about 1,000 candle-power on a 115-volt, direct-current main. For lighting these tubes Mr. Hewitt uses the ordinary direct-current supply systems at from 100 to 200 volts, the tube being started by an instantaneous wave of high potential, generated either by means of a Wehnelt interrupter or any other convenient appliance.

Mr. Nikola Tesla exhibited some exceedingly beautiful and brilliant phenomena of high-frequency and high-tension currents and showed his oscillators at work. These experiments were a repetition of those which Mr. Tesla has lately been making in connection with the control and direction of these extraordinary currents and elicited great interest and applause. Discharges of several feet in length were shown from the terminals of a resonating oscillator and vacuum lamps lighted at some distance from the energizing apparatus.

Three-Cent Fares for Cleveland.

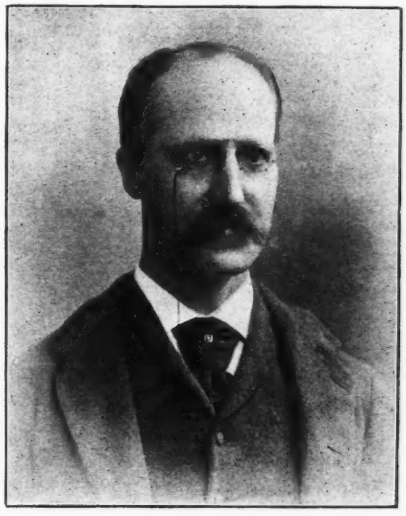
Mr. Martin Mullen, a retired coal merchant, and Mr. Albert L. Johnson, the electric railway promoter and a brother of the Mayor of Cleveland, Ohio, are agitating the three-cent street car-fare for that city, and Mr. Johnson says that he intends to double the size of the cars now in use, purposing to parallel the lines of the old companies, expecting no trouble in getting a franchise. Mr. Johnson believes that he will be able to demonstrate to the people of Cleveland that the three-cent fare is not only feasible, but a profitable venture both to people and railway company.

The newly incorporated Batavia, N. Y., Albion & Lake Ontario Railway will have a total length of 27 miles, its termini being at the intersection of Jackson and Ellicott streets in Batavia, and Point Breeze in Orleans County.

Death of Professor H. A. Rowland.

Professor Henry A. Rowland, of the Johns Hopkins University, died suddenly at his home, in Baltimore, Tuesday, April 16.

The cause of death was a general breaking down of the system. Although the professor had been in ill health for several months, it was not until a few days ago that his symptoms became at all alarming, and his death was entirely unexpected. Henry Augustus Rowland was born in Honesdale, Pa., November 27, 1848, and was graduated from Rennselaer Polytechnic Institute in 1870 as a civil engineer, engaging during 1871 in surveying a railroad in western New York. He taught for a time in Wooster University, but in 1872 returned to the Institute as instructor in physics, becoming assistant professor in 1874. He then spent a year abroad, studying with Helmholtz in Berlin and in examining physical laboratories in Europe. In 1876 he accepted the chair of physics



HENRY A. ROWLAND.

with charge of the laboratory at the Johns Hopkins University, and since then he had held that place. He was a member of the electrical congress that met in Paris in 1881, and served on the jury of the electrical exhibition there in that year, and for his services was made a Chevalier of the Legion of Honor. About 15 years ago he gained world-wide reputation by his large diffraction gratings, which are ruled, by a method of his own, directly on concave mirrors. An image of the spectrum is thus produced without the aid of lenses. According to his method as many as 48,000 lines to the inch can be made. The photographs of the solar spectrum that he succeeded in making with these gratings surpass anything else of the kind that has ever been done. In 1889 he was chosen president of the American Physical Society, and in 1895 and 1896 was given the honorary degree of LL.D. by Yale and Princeton universities, respectively. He leaves a widow and three children.

General Electric Profits.

The report of the General Electric Company for the fiscal year ended January 31 shows profits, including $419,066 from the sale of securities, and after deducting all expenses and allowances for depreciation and losses, of $6,243,792. Dividends on the preferred and common stock and interest on debentures were $1,968,289, leaving a balance of $4,275,502, which has been carried to surplus account. The previous balance was $2,353,031, making the present surplus $6,628,533. The orders received during the year aggregate $27,969,541, against $26,323,626 the previous year and $11,170,319 in the year ended January 31, 1897. The number of employés in all the works of the company is over 12,000. There were expended in the year for new patents, patent expenses and patent litigation, $360,259.

In addition the patents and good will of the Siemens & Halske Electric Company of America, the Marks Enclosed Arc Lamp Company and other concerns were acquired at a cost of $604,672, making the total expended on this account $964,931. In the last previous annual report patents, franchises and good will were carried at $2,000,000. The bookkeeping profit of the difference between the par of $3,763,000 debentures and $3,124,300 par of common stock issued therefor was credited to patents and good will. The amount is $618,057. There was written off on the same account $346,874, a total of $964,931, leaving the patents, franchises and good will standing on the books at the end of the year, $2,000,000, the same as at the beginning of the year. The three plants of the company now occupy 180 acres, and the total factory floor space of the buildings is approximately 2,362,000 square feet. The book value of these plants is $1,858,044, which is less than 80 cents per square foot of all the manufacturing floor space.

Sale of the Anchor Electric Company.

The entire stock, good will and lease of the Anchor Electric Company, of Boston, were sold at auction, April 16, by the receiver, James E. Leach, to George O. Proctor, formerly president of the company. The price paid was $17,100.

Mr. Alexander W. Sharman, the London electrical expert of Lloyds, will sail for Egypt shortly after his return to London. Mr. Sharman stated recently that he did not know exactly what he would do in Egypt as his orders had not yet been fully explained to him, but it is known that his work will be in connection with wireless telegraph apparatus and is commonly supposed to have some connection with government matters.

Telephone and Telegraph

A new company has recently been incorporated for $3,000 in New Berlin, N. Y., to install a local telephone service.

A new Kansas incorporation is that of the Hutchinson Telephone Exchange, for $25,000, incorporated by M. W. and W. S. Clay, E. J. Stearns and others.

Reports from Ohio state that the Star Telephone Company has sold its Richland County interests and its Mansfield franchise to the United States Telephone Company.

A telephone line will be built between Darien, N. Y., and Bennington during the coming season, and it is said that this will relieve the town of Bennington "of the distinction of being the only town in Wyoming County without telephone service."

A $6,000 stock company has been formed in Winder, Ga., by Judge Russell, M. D. Irwin and T. C. Dunn, to establish a local telephone exchange. As soon as the work is completed a line will be run from Winder to Athens and Atlanta.

A new corporation known as the Overland Telephone Company is said to be preparing for the construction of a telephone line from Borden to Henryville, Ky., by way of Nenze. It is said that the line will connect all the berry and fruit farms in that part of the country, and the rate charged for the service will be nominal.

A telephone line will soon be established between Sunny Side and North Yakima, Wash., by the Inland Telephone and Telegraph Company. The company is said to have assured its patrons in the latter town that a night service will be given in the near future, and that as fast as possible the system will be enlarged and improved.

Reports from Zanesville, Ohio, state that the 30 days of open stock books, during which time the company's shares were offered for popular subscription, resulted in the taking up of every dollar's worth of stock. A portion of the company's equipment is already on the ground and active operations will be begun in a few days.

The new telephone exchange of the local Bell company in Rochester, N. Y., is practically completed, so far as the building construction goes, and the electrical contractors are now installing the necessary apparatus and making the required wire connections. Because of the sharp competition between the two local telephone companies, a large number of people have been induced to become subscribers on account of the cut rates.

Two telephone companies are reported to have been recently incorporated in Austin, Tex., one being known as the Austin Telephone Company, with a capital stock of $1,000,000, and the other as the Austin City Telephone Company, with a capital of $100,000. The incorporators of the former company are Messrs. J. E. Boynton, J. B. Earle, C. H. Rose and others, and those of the last-named corporation, Z. B. Campbell, H. G. Baker and others.

Reports of the wire mileage construction of the Erie telephone system in the year 1900 shows the following condition:

	Pole Miles.	Wire Miles.
Exchange	625	73,027
Long-distance	2,585	25,907
Total	3,210	98,934

Of the 98,934 miles of wire constructed during the year, 45,957 miles were put underground.

On December 31, 1900, the system had in operation:

	Pole Miles.	Wire Mile.
Exchange	3,915	198,470
Long-distance	17,207	95,574
Total	21,122	294,044

Of the 294,044 wire miles, 95,906 are working underground.

The Extension of the Telephone Business.

In the annual report of the American Telephone and Telegraph Company for the year ending December 31, 1900, it was shown that there had been expended during that year for new construction by this company and its licensees the amount of $28,862,970.85. This is a larger amount than was necessary for the preceding six years for the same companies. In an interesting communication reviewing these figures in a comparative way in the New York *Commercial* of recent date, Mr. Fred Deland, of the Federal Telephone Company, of Pittsburgh, says:

From January, 1885, to December 31, 1893, the year the fundamental Bell patent expired, $42,000,000 was expended upon the extension and betterment of their plant, the larger items of which aggregated in round numbers as follows: Overhead and exchange construction, $12,000,000; subways and cables, $14,500,000; buildings, $6,000,000; toll lines, $9,000,000.

Since January 1, 1894, the Bell companies, not including the Long-Distance company, have expended $107,508,409 in new construction, distributed as follows:

1894	$4,549,000
1895	14,151,000
1896	9,437,853
1897	10,191,245
1898	14,213,207
1899	26,103,133
1900	28,862,971

Hence, the statement that not less than $30,000,000 will be expended in construction work each year is quite reasonable. For, though more exchange circuits were strung in 1900 than the total number in service in 1893, and though nearly as many new telephone stations were added last year (167,934) as the total of all subscribers connected to all Bell exchanges in 1891, yet published estimates of construction work planned to be completed before the close of 1902 throw far in the shade the remarkable growth presented in this year's annual report.

As the total capitalization of these companies now exceeds $300,000,000, the following tabulated statement is interesting when the fact is recalled that in 1885 the total capitalization of all the licensee companies was only $53,000,000, and that of the parent Bell $10,000,000. In the pertinent phraseology of the day, the Bell companies have finally been aroused to a condition of affairs as marvelous as it is encouraging to the telephone user. Tabulation:

American Telephone and Telegraph Company (parent Bell), from $75,000,000 to $100,000,000.

New York Telephone Company, New York city, from $16,000,000 to $30,000,000.

New York & New Jersey Telephone Company, Brooklyn, from $7,707,000 to $15,000,000.

New England Telephone Company, Boston, from $15,000,000 to $20,000,000.

Bell Telephone Company, of Philadelphia, from $4,000,000 to $8,000,000.

Central District and Printing Telegraph Company, Pittsburgh, from $4,000,000 to $7,500,000.

Chicago Telephone Company, Chicago, from $10,000,000 to $15,000,000.

Michigan Telephone Company, Detroit, from $2,500,000 to $10,000,000.

Hudson River Telephone Company, Albany, from $2,000,000 to $4,000,000.

Pacific States Telephone Company, San Francisco, $10,000,000 to $20,000,000.

Rocky Mountain Bell Telephone Company, Salt Lake City, from $1,000,000 to $2,500,000.

Colorado Telephone Company, Denver, from $1,500,000 to $3,000,000.

City & Suburban Telephone Company, Cincinnati, from $2,000,000 to $3,000,000.

Bell Telephone Company, of Buffalo, Buffalo, from $2,000,000 to $5,000,000.

Cleveland Telephone Company, Cleveland, from $1,000,000 to $4,000,000.

Central Pennsylvania Telephone and Supply Company, Williamsport, from $1,000,000 to $1,500,000.

Wisconsin Telephone Company, Milwaukee, from $3,000,000 to $10,000,000.

Bell Telephone Company of Canada, Montreal, from $3,000,000 to $10,000,000.

Central New York Telephone and Telegraph Company, Utica, from $750,000 to $1,000,000.

Central Union Telephone Company, Chicago, from (?) to $10,000,000.

Chesapeake & Potomac Telephone Company, Washington, from (?) to $4,000,000.

Cumberland Telephone Company, Nashville, from (?) to $6,000,000.

Iowa Telephone Company, Des Moines, from (?) to $1,000,000.

Nebraska Telephone Company, Omaha, from (?) to $1,500,000.

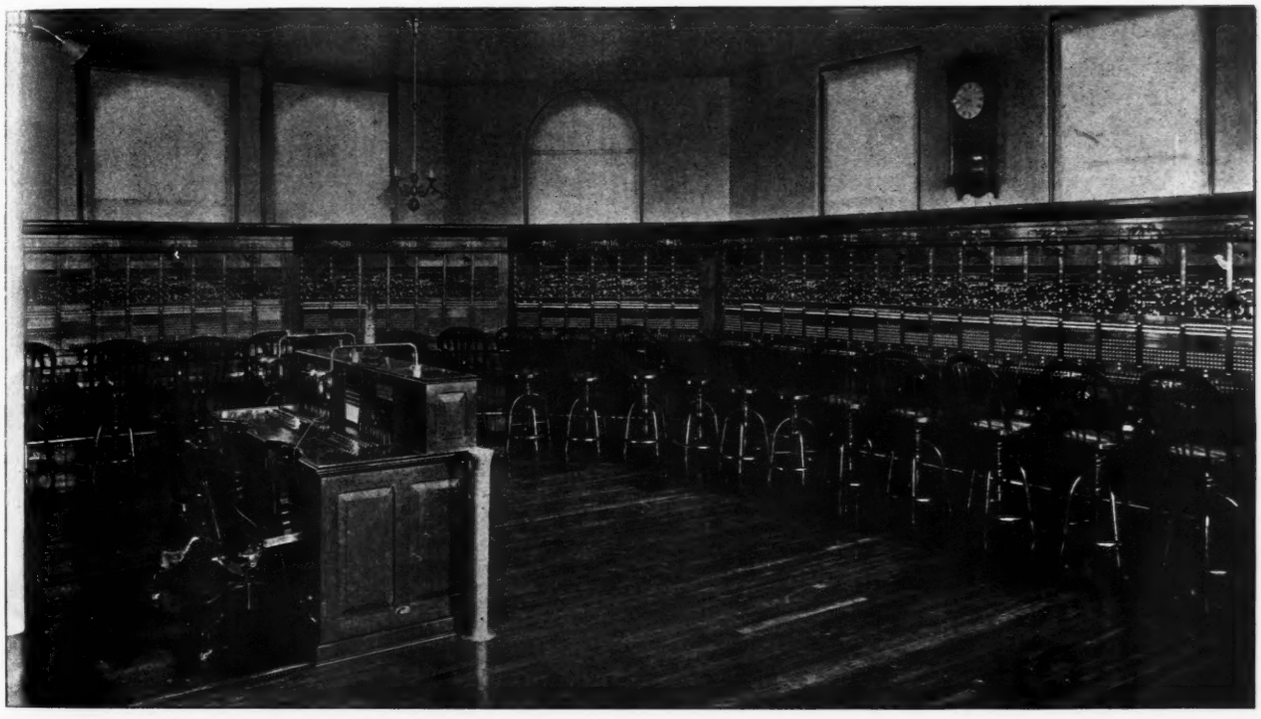
Bell Telephone Company of Missouri, St. Louis, from (?) to $2,000,000.

Missouri & Kansas Telephone Company, Kansas City, from (?) to $1,500,000.

A MODERN TELEPHONE EXCHANGE.

THE NEW SWITCHBOARD OF THE BELL TELEPHONE COMPANY, AT BUFFALO, N. Y.

An event of considerable interest in electrical and telephone circles took place recently in Buffalo, when the Bell Telephone Company, of that city, placed in service its new switchboard located in its main, or Seneca street, exchange. In the belief that some information in regard to this new installation will be of interest, representing, as it does, all that is latest and most improved in the telephone field, there is given here some description of it, accompanied by such views as will be needed to gain an idea as to its size and character.



THE MAIN SWITCHBOARD OF THE BELL TELEPHONE COMPANY'S SENECA STREET EXCHANGE, BUFFALO, N. Y.

The new switchboard has been placed on the top floor of the Telephone Building, Nos. 14 and 16 West Seneca street, erected for this purpose. The switchboard which is replaced was on the floor directly underneath, or the former top floor. As happens, therefore, in such cases, it became necessary to build the additional story and to install the new equipment, both on the new and old operating floors, and at the same time continue to give service from the old board until the new was ready for use. This work, of course, involved a large amount of labor and expense and presented no little difficulty. It was successfully completed, however, a few weeks go, and in the presence of Mr. Henry M. Watson, president of the telephone company, and a number of invited guests, the transfer was made to the new office. The time consumed in this work was less than two minutes, during which period over 3,200 subscribers were disconnected from the old board and connected into the new, and service from the latter started.

As will be seen from the illustration, the new switchboard extends around three sides of the operating room. At the present time there is room at the switchboard proper for 42 operators, which number can be increased, as the business grows, to 72 operators. In addition to the above there are also desks for four monitors or chief operators, who likewise form part of the operating force.

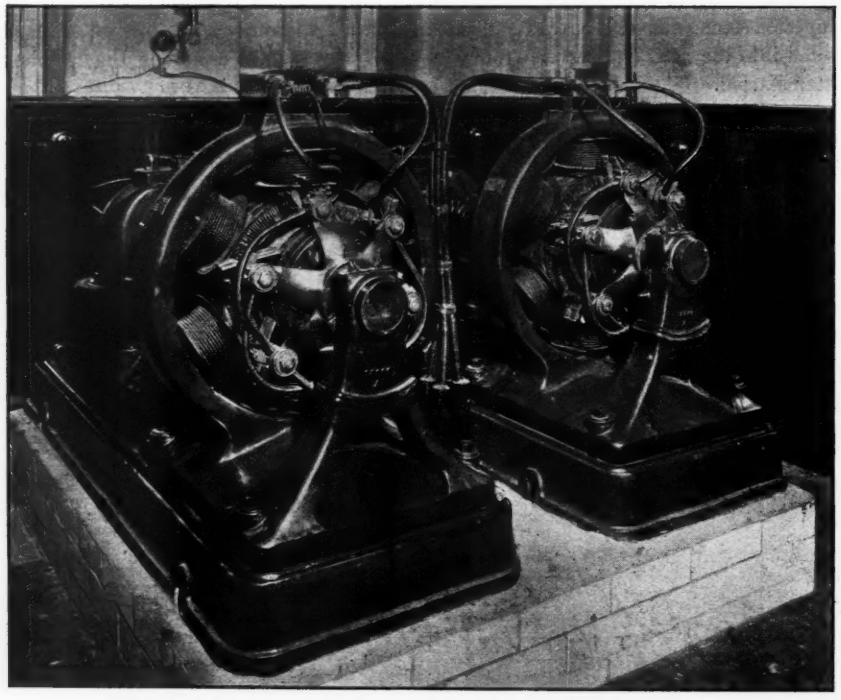
The present switchboard is equipped to accommodate about 4,500 subscribers. It can be extended, however, so as to handle 7,000 stations, which is about as many as it is expected to reach from this one office. As the Bell Telephone Company operates six other exchanges in Buffalo, this board had to be equipped with the necessary trunks, both in-coming and out-going, for handling connections to and from these other offices. The total number of such trunks that can be provided for in this new switchboard is 500.

The switchboard is of the common-battery, multiple type, in which, as most of our readers will recall, all current for calling and signaling purposes is obtained from a large storage battery located in the exchange. This battery is charged by special generators of large size, driven by direct-coupled motors, as shown in the illustration.

Signaling the central office from a subscriber's station is accomplished automatically by simply removing the telephone from the hook. This act causes a lamp to light over the answering jack in front of the operator. When the latter answers the subscriber with one of her answering cords to find out what number he wishes, this lamp is extinguished. Upon learning from the subscriber the number desired, the operator first tests the line called for to find out if it is in use at some other part of the board. If free, she inserts the calling plug, the companion to the one first used, into a spring jack before her representing the number asked for, and pushes the ringing key to signal the second subscriber. Until the latter responds to the ringing of his bell, a little lamp will burn and will continue to show until he removes his telephone from the hook, whereupon it will disappear.

During the conversation no lamps show. As soon as either subscriber hangs up his receiver, however, his own cord lamp appears, and when both are through the two cord lamps burn. The operator is thus informed as to the exact state of affairs at every station to which she is connected, and can tell whether the two subscribers are talking, whether one is through and

the other waiting for a second connection, or whether the party for which he has called and to which his own line is connected has failed to answer the ringing of his bell.

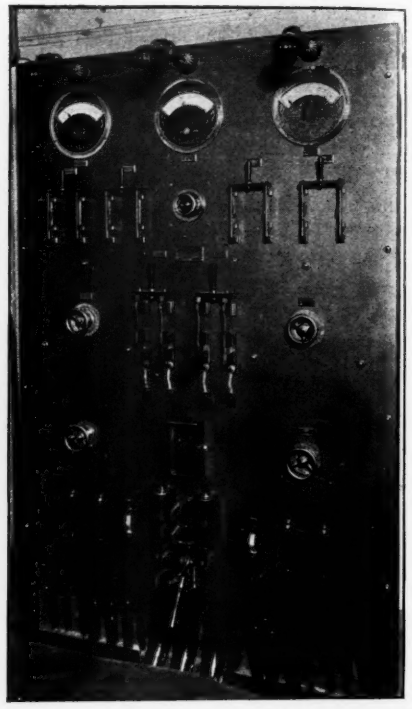


Charging Generators in the Buffalo Telephone Exchange.

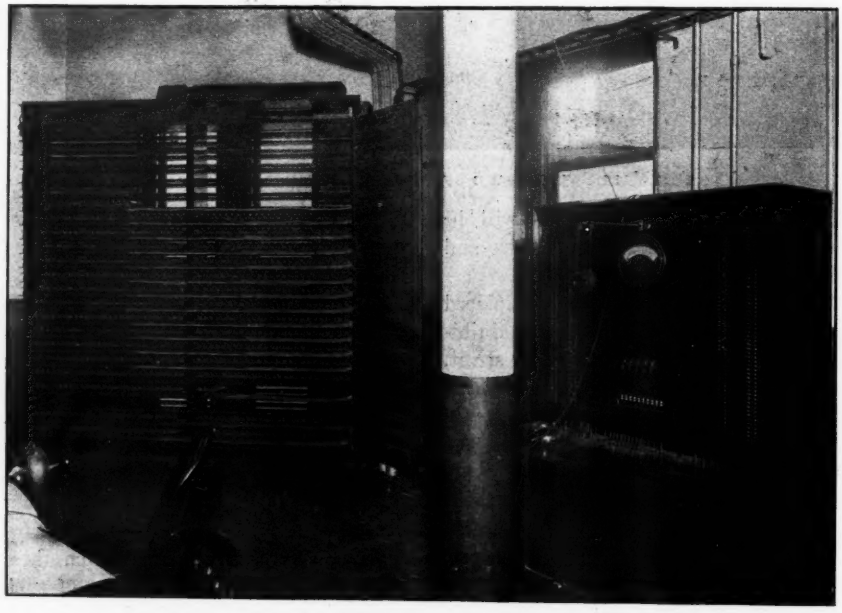
Further than this, this complete system of supervision, by means of which the operators can tell exactly what is going on by the condition of the signal lamps, and thus save the necessity of breaking in on conversations with the inquiries, "Are you through?" or "Waiting?" is made to apply even if one subscriber is in one exchange and the other to whom he is connected is in another exchange in a different section of the city. To accomplish this, of course, it was necessary to make the signals pass through one exchange over the connecting trunks to the operator in the distant exchange who first received the call.

Formerly the switchboard proper constituted about all there was to a telephone exchange. At the present time, with an equipment such as we are describing, the auxiliary apparatus inserted between the switchboard and the subscribers' lines, as they leave the building, is about as important as the switchboard itself. In the new Seneca exchange all this equipment has been placed on the floor below the new switchboard or on the former operating floor. Here is to be found the main distributing frame, to which are brought the large 200-pair underground cables from the subway and on which are mounted also the lightning and "sneak current" arresters, through which every line is made to pass before being carried to the switchboard. Here, also, have been placed the intermediate distributing racks, and the racks on which the relays for working the lamps are supported.

In one corner of the room will be seen the large rack and fuse board for the repeating coils, through which the currents pass for talking purposes. In another corner are the motor-generators for supplying the ringing currents. These are provided with attachments for giving the operators information as to lines being busy, in trouble or of failure on the part of the subscriber to answer calls and the like. To the right, also, as one enters, is seen the large ringing and battery fuse board through which the currents from the ringing machines and the large storage battery are distributed to the switchboard for the various purposes for which they are employed.



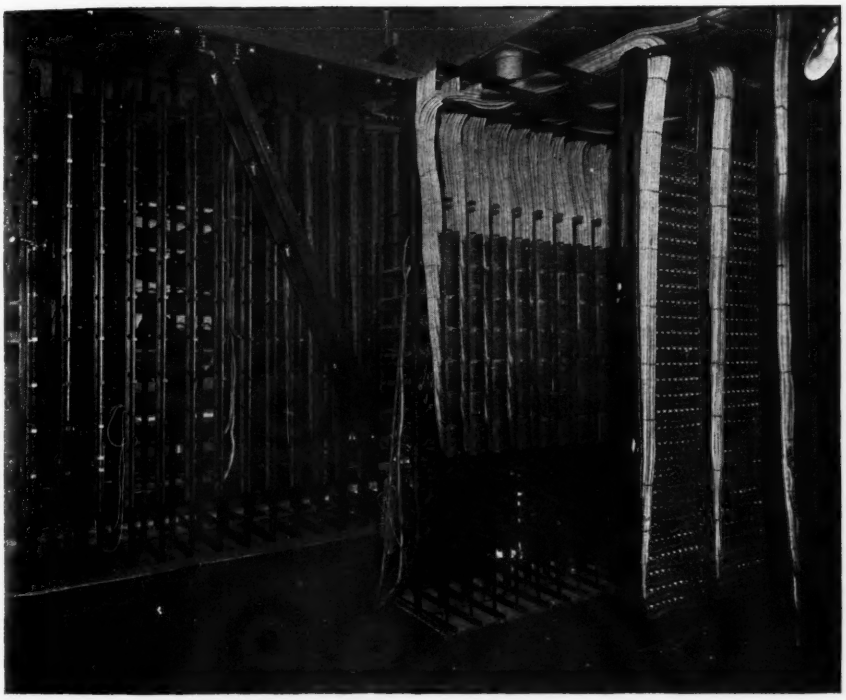
Power Switchboard in the Buffalo Telephone Exchange.



Repeating Coil Rack in the Buffalo Telephone Exchange.

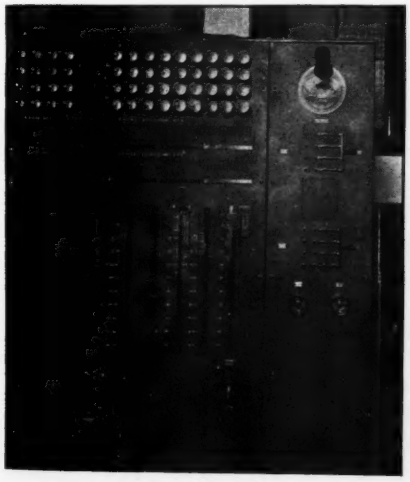
It is evident, of course, that with all the complicated equipment now found in a central office, such as has been noted above, considerable facilities would be needed for

testing, locating and removing troubles both inside and out of the exchange itself. For this purpose, the wire chief's desk, shown in the illustration, provided with elaborate testing apparatus, has been added, as well as a separate desk for testing and making connections to the large number of toll and long-distance lines that enter the main exchange.



DISTRIBUTING FRAMES IN THE BUFFALO TELEPHONE EXCHANGE.

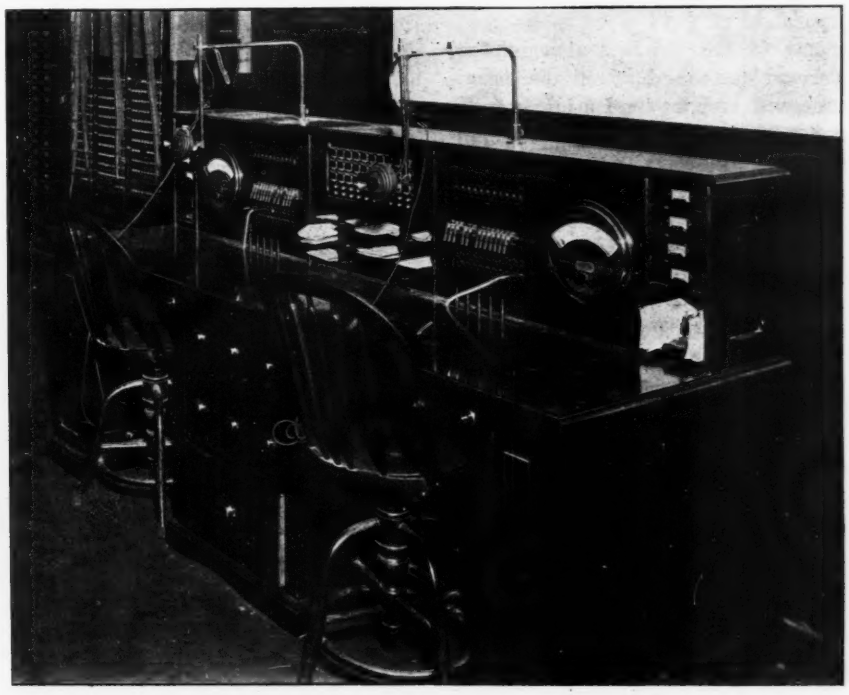
Besides the Seneca office, the Bell Telephone Company at the present time is equipping all its branch offices with switchboards of the same type as has just been outlined, so that in a few months it is expected that the entire city will have the improved service.



FUSE PANEL IN BUFFALO EXCHANGE.

This same work has already been completed in the cities of Rochester and Niagara Falls.

While in character and excellence the Seneca street exchange is identical with the recent expensive installations by the Bell companies in Boston, New York, Philadelphia and elsewhere, and will compare favorably with them in size, in one particular it is somewhat unique. As is well known, in Buffalo the street cars are run and heated by Niagara power, and the same agency lights the avenues and houses, prints the newspapers and in many other ways is made to serve the community. Probably the most far-reaching effect of its force, however, manifested wherever the great long-distance system of toll lines extends, results from the employment of Niagara power to drive the motor-generators above referred to. When talking from Buffalo to Boston, Minneapolis, St. Louis or Atlanta the great cataract furnishes the necessary energy. That its mighty power can be thus transformed into speech and transmitted hundreds of miles away is certainly not the least of the achievements of the century that has recently closed.



WIRE CHIEF'S DESK IN THE BUFFALO TELEPHONE EXCHANGE.

This entire equipment was manufactured and installed by the Western Electric Company, of New York and Chicago.

F. P. Fish to Be President of the Bell Telephone Company.

Frederick P. Fish was elected, on Wednesday of this week, director of the American Bell Telephone Company and of the American Telephone and Telegraph Company. He has accepted the post of president of these companies and will take office on July 1, 1901.

Mr. Fish is a well-known lawyer of fine ability and was the attorney for the Bell telephone interests in the recent Berliner case. For several years he has been the leading counsel of the General Electric Company, and is a member of the present Board of Patent Control of that company and the Westinghouse Electric and Manufacturing Company.

Messrs. E. S. Aldrich, of Livingston, Mont., and J. G. Brown, of Duluth, Minn., have recently purchased the electric lighting plant at Snohomish, Wash. It is the intention of the new purchasers to change the present direct-current system to alternating, and they will also double the capacity of the plant.

Ohio Independent Telephone Association's Convention.

The annual convention of the Ohio Telephone Association, formerly called the Ohio Independent Telephone Association, was held at the Chittenden Hotel, Columbus, Ohio, on April 5. Eighty-five companies were represented by 131 delegates. These companies operate over 4,000 miles of toll line and more than 42,000 telephones.

After an address of welcome by Mr. H. A. Lanman, president of the Columbus Citizens' Telephone Company, Mr. John Y. Russell, secretary of the Columbus Board of Trade, delivered an address, to which Judge James M. Thomas, president of the association, responded.

The first paper was read by Mr. K. F. Briggs, of Tiffin, Ohio, the subject being "Our Country Patrons." This paper was an intelligent discussion of the problems of rural line building and supplying telephone service in country districts. The second paper, on "The Finances of Telephone Companies," was read by Mr. James B. Hoge, secretary of the United States Telephone Company.

A considerable discussion arose over the provision of a fund to defend independent companies in case the Berliner patent suit should be carried to a higher court. It was announced by Mr. Hoge that $25,000 was the sum necessary to raise for this purpose.

Some of the members thought that it should be the duty of the manufacturers to bear the burden in case a defence was needed. Judge Thomas protested against this view. He said the money would be utilized for the defence of the Berliner and Carty patent suits, and, in event of a surplus, that the money would be returned to the members of the association. After some discussion a motion that the amount be raised *pro rata* was carried, and Mr. Hoge was made trustee of the fund with authority to collect it at once.

Reports from various companies were received showing that the independent telephone business in Ohio is in a highly flourishing condition. There were no less than nine companies represented, each of which operates more than 1,000 telephones, the largest of them, the Cuyahoga Telephone Company, of Cleveland, having 6,050 telephones connected.

Reports received indicate that the Bell companies in Ohio are showing a desire to compromise with the independent corporations in the matter of division of territory. Secretary H. D. Critchfield made a strong address against compromising with the Bell companies.

As there has been no standard method of appraising telephone properties, a board of arbitration was appointed to confer with the state officials. This board consisted of Messrs. H. D. Critchfield, chairman; Edwin Kibler, D. J. Cable, Hagerty, Davis and Dougherty.

During the noon recess the delegates visited the exchange of the Columbus Citizens' Telephone Company.

The afternoon session was opened with a paper by Mr. G. P. Thorpe on "Toll Lines." The paper was devoted to an exposition of the advantages of toll lines as auxiliaries to local exchanges. The paper resulted in an interesting discussion and exchange of experiences. Mr. W. W. Morrison, Mr. Briggs, Mr. Kibler, Mr. Hildebrand and others participated in the discussion.

Judge James M. Thomas was reelected president and Mr. H. D. Critchfield secretary by acclamation. Messrs. B. J. Cable, of Lima, and C. Y. McVey, of Youngstown, were elected first and second vice-presidents, respectively. Among those representing the trade who were present were Messrs. F. B. Cook, Sterling Electric Company, Lafayette, Ind.; C. W. Stigler, Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill.; W. W. Affleck and F. C. Anderson, of the John A. Roebling's Sons Company; P. J. Eubanks, of the American Electric Telephone Company, Chicago, Ill.; I. T. Maltby, of the Maltby Lumber Company, Bay City, Mich.; H. T. Reynolds, of the Miller-Knoblock Electric Manufacturing Company, South Bend, Ind.; A. M. Kellogg, W. N. Taylor and R. H. Manson, of the engineering department, and A. J. Rousseau and H. B. Hanford, of the commercial department of the Kellogg Switchboard and Supply Company; Mr. J. A. Russell, of the National Automatic Telephone Company, and a number of others.

Among the companies that exhibited their apparatus were the National Automatic Telephone Company, Chicago; the Kellogg Switchboard and Supply Company, Chicago; the Erne-Hopkins Company, of Columbus (exhibiting insulated wire), and others.

Mr. Joseph B. Baker, experienced in telephone and manufacturing work, has entered the field of electrical engineering, with offices in Boston. Mr. Baker is a graduate of the Massachusetts Institute of Technology and for the past two or three years has devoted himself to experimenting with telephone relays.

PERSONAL.

Mr. A. L. Shultz, formerly the president and general manager of the Ashland Bridge and Iron Company, of Pittsburgh, Pa., has been appointed to take charge of the operating department of the American Bridge Company in the Pittsburgh district, which comprises the Keystone, Pittsburgh, Ashland and Schiffler plants, at Pittsburgh; the wrought-iron plant, at Canton, Ohio; the new Columbus plant, at Columbus, and the Youngstown plant, at Youngstown, Ohio.

Mr. W. T. McDowell, who has had a number of years of electrical training in actual work in the power-house and in construction matters also, has associated himself with the Electric Motor and Equipment Company, of Newark, N. J.

Mr. Arthur Warren, of the Westinghouse Electric and Manufacturing Company, returned last week after an absence of several months in Europe. The foreign Westinghouse interests are expanding very rapidly.

Mr. Arthur Stanley Riggs, of the editorial staff of the ELECTRICAL REVIEW, and Miss Elizabeth Adams Corey were married in Brooklyn, N. Y., on April 15.

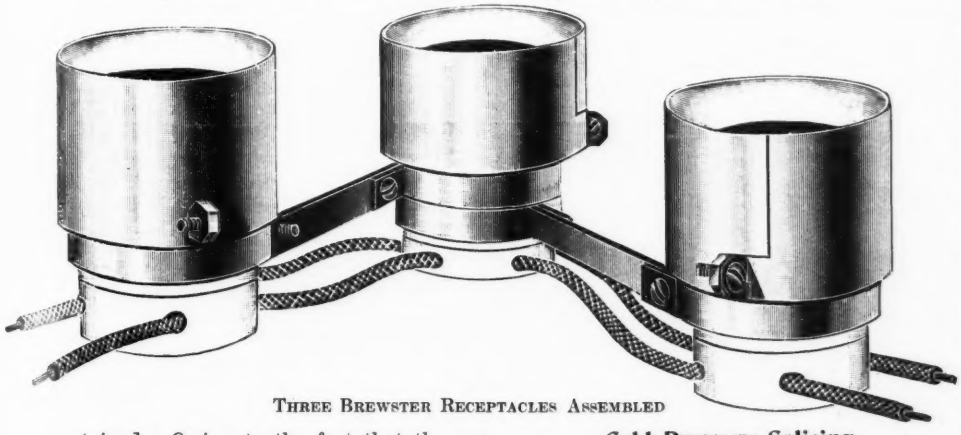
OBITUARY.

Dr. William Jay Youmans, for many years editor of the *Popular Science Monthly*, died on April 10, from typhoid fever, at his home at Mt. Vernon, N. Y., after an illness of 10 days. Dr. Youmans was born on October 14, 1838, near Saratoga, N. Y., and graduated at the Sheffield School, Yale University, also graduating in medicine in 1865. In 1875 he established the *Monthly*, and has been its sole editor since the death of his brother, with whom he had been associated in its management. Dr. Youmans is survived by a wife, a son, Dr. Vincent D. Youmans, and two daughters, one of whom, Dr. Alice C. Youmans, is a practicing physician in New York.

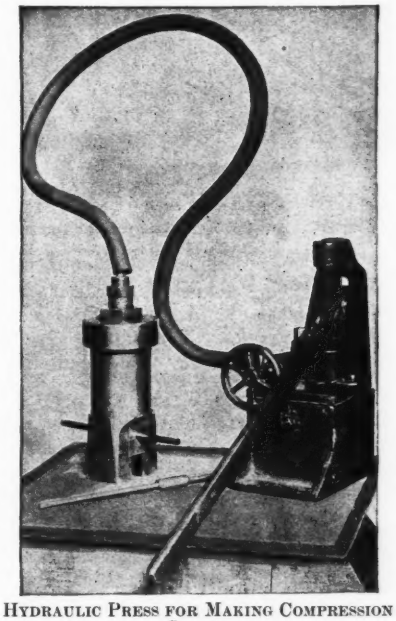
Edwin Holmes, president of the Holmes Protective Electric Company, Brooklyn, N. Y., who died at his home on January 17, in his eighty-first year, organized the Holmes Protective Electric Company. The committee of directors of the company with which Mr. Holmes was lately connected, at its quarterly meeting on April 5, passed resolutions of esteem and affection, stating the company's loss and appreciation of the value of his services. The resolutions were forwarded to his family to whom the sympathy of the company and his many business acquaintances was extended.

New Sign Receptacles and Attachments.

A new class of material, by means of which anything in the way of electrically illuminated signs or decorations for the interior or front of buildings may be quickly made up and changed, has recently been put on the market by the Electric Motor and Equipment Company, of Newark, N. J. These signs are a considerable improvement over the common type of sign and decorative work, which when once made up must necessarily remain the same. The accompanying illustration shows the style of the receptacle and its method of use so as to suggest the different purposes of every-day necessity to which it may be adapted. The receptacles themselves are linked together by S-shaped clamp hooks which bind firmly about the receptacle, thus clamping the whole structure into a rigid outline of any design or proportion desired. For indoor use the receptacles may be easily wired, using contacts projecting at the back of the main receptacle, or for outdoor use and in an exposed position, where weather-proof construction is desirable, the wires may be run through openings in the contact cap provided for that purpose, and the contact cap is then attached to the receptacle proper by means of a screw passing through the base of the receptacle into a nut imbedded in the contact cap. The space between the wires and holes in the contact caps through which the wires pass may then be filled in with some water-proof compound and a thoroughly water-tight and safe construction obtained. Owing to the fact that the contact caps are placed at regular intervals, the same contact caps and the same wiring may be used in connection with designs entirely different from the one from which they were originally made up, as it is not necessary to change the wiring excepting in rare instances. As an additional protection to the lamp and socket, when used in exposed positions, a metal rain-guard is provided. This rain-guard is adjustable upon a projecting shoulder of the receptacle, so that by moving it in or out it readily adjusts itself to the neck of an incandescent lamp of any size or shape, making a practically water-tight junction between the metal cap and the bulb of the lamp. These receptacles have already found much favor with the larger users of electrical signs, especially in theatres, and electric lighting companies, where a frequent change of reading and design is necessary. The illustration herewith shows three of the receptacles assembled and illustrates how easily they may be grouped in any form.



THREE BREWSTER RECEPTACLES ASSEMBLED



HYDRAULIC PRESS FOR MAKING COMPRESSION JOINTS.

Cold Pressure Splicing.

At the recent *conversazione* of the American Institute of Electrical Engineers Mr. H. F. Sanville showed a hydraulic press for the splicing of wires and cables by means of a solderless cold-welding process. This press, weighing only 30 pounds, is capable of exerting a pressure of 20 tons.

Mr. Sanville spliced a number of pieces of No. 3 cable to illustrate the operation of the press to those interested, and explained that the press exhibited was capable of splicing all sizes of wire or cable up to No. 0000, but if it were necessary to splice wire or cable of sizes larger than No. 0000 and not larger than 1,000,000 circular mils, it would be necessary to use the next size larger press, capable of exerting a pressure of 50 tons, and weighing about 80 pounds complete. The press is connected to the pump by a flexible tube, which renders it impossible to move the press to any point without shifting the position of the pump. A number of terminals were exhibited, fastened to leads by means of this solderless method, showing the insulation perfect up to the shoulder of the terminal, there having been no heat or acid used to cause its destruction.

The press and pump exhibited were provided by the Splice and Terminal Company, No. 15 Cortlandt street, New York city.

The Selling Organizations of the Bullock and Wagner Companies Unite.

The Bullock Electric Manufacturing Company, of Cincinnati, and the Wagner Electric Manufacturing Company, of St. Louis, have effected a combination of their selling organizations.

By thus combining forces in the field, they are mutually benefited, as the products of the two companies are totally different, and where the product of one is used, the other is likely to be necessary.

The product of the Bullock company consists of a complete line of direct and alternating-current machines, from a one-half horse-power motor to a 10,000-kilowatt generator; controllers of various types and rotary transformers. The Bullock "Teaser" power system for driving large daily newspaper presses has become world famous and is to-day installed and giving the best results in the press rooms of the leading dailies in Europe and America.

The product of the Wagner Electric Manufacturing Company covers a full line of static transformers of all types and of the largest sizes; ammeters, voltmeters, indicating wattmeters, switches, switchboards for all purposes, and single-phase, self-starting, alternating-current motors. The entire absence of complicated starting mechanism especially adapts the Wagner single-phase motor to pumping plants and machinery of like character.

The two lines, it will be noted, are admirably adapted to be sold by one organization. This will be under the able management of Mr. E. H. Abadie, formerly sales manager of the Wagner company.

Corporation News

STRASBURG, OHIO—Strasburg Electric Company. $10,000.

OSHKOSH, WIS.—Fox River Gas and Electric Company. $350,000.

BONHAM, TEX. — Chickasaw - Choctaw Telephone Company. $10,000.

WELLSTON, OHIO — Jackson County Home Telephone Company. $50,000.

WINTHROP, MINN.—People's Independent Telephone Company. $10,000.

MAYSVILLE, KY.—Maysville Telephone Company. $5,000. Incorporator: J. W. Chambers.

LAUREL, DEL.—Laurel-Seaford Electric Light Company. $20,000. Incorporators not named.

ANNA, ILL.—Advance Telephone Company. $17,500. F. W. Willard, E. Samson and G. A. Bell.

CHICAGO, ILL.—Monarch Electric and Wire Company. $25,000. Incorporators: S. J. Howe, R. R. and M. C. Kellar.

FARINA, ILL.—The Farina & Vandalia Telephone Company has increased its capital from $2,500 to $5,000.

BROOKLYN, N. Y.—Amusement Electrical Company. $4,000. Directors: A. J. Moore, H. C. Bolton and G. W. Woods.

BILLERICA, MISS. — Billerica Electric Company. $20,000. W. A. Dicuker, president, and C. S. Cummings, treasurer.

NEW YORK, N. Y.—Joy Printing Telegraph Company. $30,000. Directors: O. J. Smith, G. W. Cummings and J. H. Grant.

TRENTON, N. J.—American Light and Traction Company. $2,000. Incorporators: E. McMillin, C. T. Scoville and C. N. King.

CAMDEN, N. J.—E. L. Rowe. To manufacture electrical supplies. $50,000. Incorporators: H. E. Rowe, H. C. Gramborn and S. C. Hoffman.

EAST ORANGE, N. J.—American Home Telephone Company. $2,000,000. Incorporators: A. G. Brown, E. B. Hawkins and E. T. Magoffin.

LAWRENCEVILLE, ILL. — Lawrence County Telephone Company. $3,500. Incorporators: S. J. Gee, A. N. Fink and A. M. Maxwell.

SULLIVAN, ILL.—Sullivan Telephone Company. $10,000. Incorporators: S. H., John L. and James L. Kirk, J. R. Pogue and A. O. Harrison.

GARRETT, IND.—Garrett, Auburn & Northern Electric Railway Company. $10,000. Directors: F. S. Mitchell, E. B. Johns and others.

HANNIBAL, MO.—Miller Township & Hannibal Telephone Company. $2,000. Directors: Judge Jasper Turner, J. H. Knoth and others.

PALMYRA, N. Y.—Palmyra Electric Railway Company. $45,000. Directors: C. A., D. E., C. F. and A. C. Lux, E. W. Weeks and others.

NEW YORK, N. Y.—National Battery Company. $500,000. Incorporators: W. B. Greeley, C. A. Wendell, R. S. Nichols and others.

EASTON, PA.—Imperial Power Company. $100,000. Incorporators: H. Mitchler, C. L. Hemingway and R. A. Montgomery.

LORAIN, OHIO—Lorain Steel Motor Company. $600,000. Incorporators: A. G. Brown, E. W. Ulmer and E. T. Magoffin.

NEW ORLEANS, LA.—New Orleans Lighting Company. $2,000,000. Incorporators: H. B. Royson, C. F. Schumann, M. M. Butler and others.

CLEBURNE, TEX.—Cleburne Light and Power Company. $20,000. Incorporators: J. B. Oliver, S. C. Padelford and R. B. Stitcher.

TEMPLE, TEX.—Bell County Telephone Company. $120,000. Incorporators: J. K. Duffy, J. S. Brailey, Z. B. Campbell and others.

GENESEE, N. Y.—Genesee & Orleans Railway Company. $350,000. Directors: G. W. Aldridge, F. P. Allen, C. E. Hart, C. H. Babcock and others.

DOVER, N. H.—Dover, Summersworth & Rochester Street Railway Company; $300,000. Concord, Dover & Rochester Railway Company; $400,000.

TOLEDO, OHIO — Toledo & Findlay Traction Company. $1,500,000. Incorporators: George S. and G. B. Kerper, Henry Burkhold and others.

CAMDEN, N. J.—Consolidated Telephone and Telegraph Company. $100,000. Incorporators: F. R. Hansell, Max Phillips and R. W. Miller.

EAST ST. LOUIS, ILL.—St. Louis Valley Railway Company. $50,000. Incorporators: W. S. Forman, W. R. Sackett, F. V. Dubrouil and others.

JEFFERSON CITY, MO.—The Bell Telephone Company of Missouri has increased its capital stock from $2,000,000 to $4,000,000.

DETROIT, MICH. — National District Telegraph Company of Michigan, Limited. $10,000. Directors: H. D. Bennett, G. R. Johnson, H. E. Spalding and others.

BRATTLEBORO, VT.—Brattleboro Automobile Company. $20,000. Incorporators: G. W. Hooker, R. E. Gordon, F. D. Fisk and others.

UTICA, N. Y.—The Central New York Telephone and Telegraph Company has increased its capital stock from $800,000 to $1,000,000.

AUSABLE FORKS, CLINTON COUNTY, N. Y.—Ausable Electric Light and Power Company. $25,000. Directors: James Rogers, George Cahoon and J. M. Sheffield.

PHILADELPHIA, PA.—Philadelphia, Trenton & New York Railroad Company. $500,000. Incorporators: Thomas B. Lynch, Frank S. Drake, C. M. Bates and others.

BATAVIA, N. Y.—Batavia & Lake Ontario Railway Company. $350,000. Incorporators: George W. Aldridge, Charles E. Hart, John H. Gregory, John F. Kinney, F. P. Allen and Frederick W. Zoller.

SONORA, TUOLUMNE COUNTY, CAL.—Mountain Automatic Telephone Company. $50,000. Paid-up stock, $1,250. Directors: P. N. Keefe, W. S. Griffith, M. S. Sanford and others.

ELLENVILLE, N. Y. — Ellenville & Kingston Railroad Company. $300,000. Directors: T. H. Fowler, J. B. Kerr, O. D. Ashley, A. S. Roe, G. B. Schley and others.

PORT CHESTER, N. Y.—New York & Port Chester Railroad Company. $250,000. Directors: Charles Heinecke, M. H. Germend, W. H. Heath, M. H. Baldwin, E. D. Mailloux, M. Kendall and others.

HURON, OHIO—Messrs. T. H. Knapp and C. K. Callaghan, of Belleview, have purchased the Huron Telephone Company, operating in Huron, Sandusky, Seneca, Erie and Crawford counties. The company's paid-up capital is $30,000.

DAYTON, OHIO—Dayton & Xenia Traction Company; $800,000; incorporators: C. J. Ferneding, E. Canby, O. O. Ozias, J. E. Carson and H. L. Ferneding. The Dayton & Troy Electric Railroad Company has increased its capital stock from $30,000 to $1,000,000.

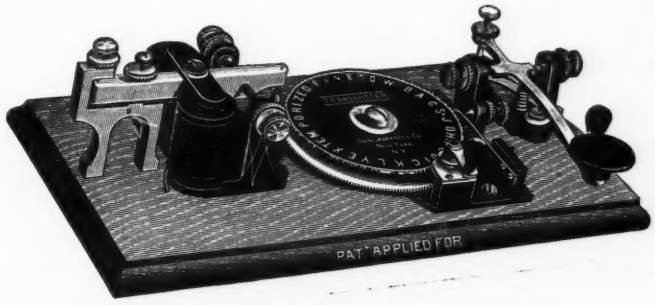
IOLA, KAS.—A company is to be formed in this town within a few days to build a system of electric railways extending from Iola to surrounding towns in the Kansas gas belt. The capitalization will be $50,000. The directors are S. A. Bowles, L. L. Northrup, F. W. Clinkscales and others.

HARRISBURG, PA.—Charters were issued recently by the State Department to the following railroad companies, which are supposed to be under the management of Albert B. Kelly, of Philadelphia, and the total capitalization is $199,500: Westchester & Wilmington; Chester, Wayne & Norristown; Philadelphia, Wayne & Westchester; Parkersburg and Coatesville; Coatesville, Downington & Westchester; Philadelphia, Norristown & Phœnixville, and Philadelphia, Media & Wilmington Street Railway companies. Charters were also granted to the Jersey Shore Railway Company, of Jersey Shore, N. J., which is capitalized at $25,000, and the Reading, Pa., Birdsboro & Pottstown Railroad Company, with $10,000 capital.

The Omnigraph.

The omnigraph is an instrument for teaching telegraphy, and is designed to simplify instruction and to impart, in a comparatively short time, a full knowledge of the Morse alphabet. This ingenious instrument may readily be understood by inspection of the illustration. It consists of a base board on which are secured an ordinary key and sounder, between which is mounted a disk having teeth upon its periphery. A spring contact adjacent to the wheel engages with these teeth. Although irregular, the arrangement of the teeth is not arbitrary. If the disk be rotated by means of the small crank shaft which is geared with it, the spring contact engages successive teeth, making and breaking the circuit and sending into the sounder the impulses making the dots and dashes of the Morse alphabet. The disk contains a sentence ingeniously devised to include every letter in the alphabet. It can be turned by the student's hand as slowly or as rapidly as he wishes, thus distinctly making the sound of the letters on the sounder and enabling the student to study by himself without an instructor to send to him.

The instrument is manufactured by the Omnigraph Manufacturing Company, of New York city, Mr. C. E. Chinnock, long and well known in the electrical fraternity, being its president.



THE OMNIGRAPH.

Insulated Pliers.

In the accompanying illustration is shown a variety of insulated side-cutting pliers recently placed upon the market by the Smith & Hemenway Company, New York city. The handles are covered with rubber, thereby insulating them completely. The rubber is formed on the handles in such a way as to increase their adhesion to the hand, thus securing perfect grip, and the rubber insulation itself is seamless, thus avoiding a danger which has occasionally been noticed in insulated pliers where the insulating covering was not perfectly homogeneous.

INSULATED SIDE-CUTTING PLIERS.

Wall Street and the Electrical Stock Market.

On the New York Stock Exchange, General Electric closed the week at 226 bid and 227 asked, showing a gain of 10 points. It reached 234 on rumors of big stock dividends. Metropolitan Railway, of New York, closed at 168½ bid and 169 asked, indicating a gain of 1¾ points. Brooklyn Rapid Transit closed the week at 83⅜ bid and 83½ asked, showing a gain of ⅝ point. Third Avenue Railroad closed at 122 bid and 125 asked, showing a gain of 1 point. Manhattan Railway, of New York, closed at 128⅝ bid and 128¾ asked, indicating a loss of ⅞ point for the week.

On the Boston exchange, American Telephone and Telegraph closed the week at 171 bid and 171½ asked, indicating a gain of 1 point. Erie Telephone closed at 60½ bid and 61½ asked, showing a gain of 10½ points.

On the Philadelphia exchange, Electric Company of America closed the week at 8⅝ bid and 8⅞ asked. Union Traction closed at 31¼ bid and 31½ asked. Electric Storage, common, 67 bid, a gain of 2 points.

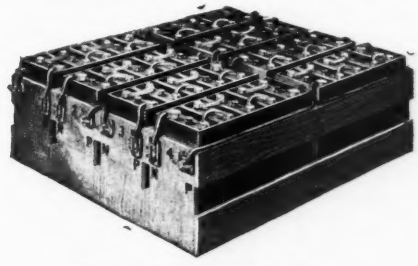
On the curb, or outside market, in New York, Electric Vehicle closed at 12½ bid and 15 asked, showing a gain of 2 points. Electric Boat closed at 20 bid and 22 asked. Consolidated Electric Lighting and Equipment Company closed at 7⅜ bid and 8 asked.

Wall street, April 13.

VEHICLE USED IN TESTS OF PORTER AUTOMOBILE BATTERY.

A New Storage Battery.

The Porter Battery Company is manufacturing, at Waukegan, Ill., storage batteries particularly intended for automobile use. The batteries are arranged in boxes with strong side handles, the top and one end being held in position by screws so that when these are removed the batteries may be drawn from the case in a handy and convenient way. The batteries are claimed to give extraordinary satisfaction in automobile work, the accompanying illustration showing a road wagon which has been in use about a year and is said to have often done 60 miles on one charge of a No. 9 Porter battery, weighing 540 pounds. A strong claim is made by the company that its batteries maintain a high and constant voltage until the end of their charge.



PORTER AUTOMOBILE BATTERY.

Industrial Notes

THE AMERICAN STOKER COMPANY, Mr. H. C. Spaulding, New England manager, has removed from its office in the Exchange Building, Boston, to 176 Federal street.

THE MICHIGAN PIPE COMPANY, Bay City, Mich., says the process of creosoting its conduit prevents any vegetable growth from reaching them. They are made in any size desired by the purchaser.

THE STANDARD WELDING COMPANY, Cleveland, Ohio, has recently issued its catalogue No. 4 on automobile parts. The pamphlet contains matter of interest and will be mailed gratis to any one interested on application.

THE RAVEN MINING COMPANY, with offices in the Marquette Building, Chicago, has upon the market for the electrical trade a mineral product termed "Bonita," used for insulating purposes. It has met with much success.

THE MILWAUKEE ELECTRIC COMPANY, of Milwaukee, Wis., states that it will be several months before it will be able to move to the new factory in that city, owing to the fact that it is not yet completed. The company is very busy filling orders.

EUREKA ELECTRIC COMPANY, Chicago, has removed from its old quarters into a much larger factory. The increased space will greatly facilitate the manufacture of telephones and switchboards, for which there is great demand.

ELECTROLYSIS PROOF CONDUIT COMPANY, 605 Manhattan Building, Chicago, claims for its asphalt paper conduit that it is an absolute non-conductor and is guaranteed to stand 50,000 volts. It is made for both underground and interior purposes.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has recently sent out its bulletins Nos. 3,008 and 3,024, descriptive, respectively, of its induction sewing machine motor and its standard manufacturing sewing machine, fitted with an electric motor.

THE RICHMONDT ELECTRIC WIRE AND CONDUIT COMPANY, of Milwaukee, Wis., states, through Mr. C. D. Richmondt, that the company's plant will be removed from Milwaukee to Waukesha, Wis., where it will occupy a larger factory with greatly increased facilities.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has in its present issue of *Graphite* a number of short articles showing the adaptability of graphite as a lubricant to all purposes, and one in particular, a "Mystery in Lubrication," is to be recommended.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., is mailing bulletins on speaking tubes, annunciators and combination letter boxes. The company manufactures a large and extensive line of this material, and will be pleased to furnish descriptive matter on application.

MR. FRANCIS RAYMOND has established offices at 48 West Jackson Boulevard, Chicago, and will deal in pure cast copper, electrical machinery and appliances. Among the companies he represents are the General Incandescent Arc Light Company and the Process Copper and Brass Company.

THE CENTRAL ELECTRIC COMPANY, of Chicago, carries in stock large quantities of construction material, such as cross arms, pins, brackets, insulators and wires. By making a specialty of prompt shipments, this company is in a peculiarly good position to handle large construction orders.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is carrying a stock of standard apparatus at the Westfield, N. J., factory and at the company's New York office, 136 Liberty street. This company has facilities at its Westfield factory for manufacturing any special motor controlling devices very promptly.

PACIFIC ELECTRIC COMPANY, at La Crosse, Wis., states that it will be pleased to send to all those interested in telephones, circulars and information regarding its new "Pacific 'Phones". Its intercommunicating system is equipped with Johnson's automatic switch and has met a ready sale. The company also makes a specially convenient telephone for residence work.

THE McROY CLAY WORKS, Brazil, Ind., and New York city, has issued its monthly calendar for April, done this time in brown. The centre of the calendar bears a humorous phrase called the "Ten Little Lodgemen." The verse is good. Descriptive matter will be mailed to any one interested on application to the company, and the McRoy conduits are too well known to need any elaboration.

THE EUREKA ELECTRIC COMPANY, of Chicago, Ill., announces that within a few days its offices will be moved to the new Eureka Electric Building at 143-145 South Clinton street. The company will occupy the entire building and announces that its new flashlight switchboard will be ready for the market within 60 days. Full particulars will be mailed to any one interested on application to the company.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, is mailing a neat calendar for April, which bears upon its face, besides the calendar itself, a very neat moresque design, in the centre of which is seated a polycolored clown with cap and bells. Catalogues of the company's products, with particular reference to motors and generators of all descriptions, will be mailed upon application.

THE KEASBEY & MATTISON COMPANY, Ambler, Pa., the owners of patents for magnesia covering, have instituted a suit in the United States Circuit Court for the Southern District of New York against the Philip Cary Manufacturing Company and a number of other defendants, to restrain them from making and selling magnesia covering, for boilers and steam pipes, containing more than 50 per cent of magnesia, and more especially covering containing 85 per cent of magnesia.

THE PELTON WATER WHEEL COMPANY, San Francisco and New York, has issued its 1901 catalogue, a handsome 64-page pamphlet, neatly bound, containing full descriptions of the company's wheels, and illustrated with a number of fine engravings showing installations of the Pelton wheels, and giving tables of value regarding the loss of head in pipe by friction, and lists of power and weight. The catalogue will be mailed on application to any one interested, and is of particular interest to engineers contemplating electric power installations.

THE WARREN ELECTRIC AND SPECIALTY COMPANY, Warren, Ohio, is mailing, with its compliments, a handsome catalogue of Peerless electric fans for use with direct current. It is handsomely gotten up on heavy calendered paper, numerous illustrations and clear descriptive matter, making the book worthy of attention by any one interested in electric fans. The book is bound in heavy brown paper and stamped in dark brown and gold. It will be mailed post free upon application to the company.

THE CENTRAL ELECTRIC COMPANY, 264 to 270 Fifth avenue, Chicago, Ill., states that the enclosed D. and W. fuse is rapidly coming into general use throughout the West, and that the entire list of D. and W. products, including motor cutouts and safety devices of all kinds, are meeting with hearty support through the company's territory. The devices are said to reduce the danger of fire through the blowing of fuses to a minimum, being a great protection to life on high-tension circuits. The Central Electric Company will be pleased to send illustrated circulars and descriptive matter upon application.

THE MORRIS ELECTRIC COMPANY'S advertiser for the current month contains the second part of Professor Elihu Thomson's New York *Sun* article on progress in electricity during the past century, besides a quantity of valuable advertising material and a number of engineers' cards. The Morris Electric Company is a manufacturer, dealer and exporter in electric railway equipment and construction and maintenance material. The company's catalogue will be sent upon application to any one interested. Requests should be mailed to 15 Cortlandt street, the New York office of the company.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., believes that this is the time of year when lightning arresters should be bought, as they can now be installed in the Spring before the thunder-storms of the early Summer approach. The company is also mailing descriptive matter of the Packard lamps, telling how it sells them and stating that these lamps were used by the United States Government on its building at the Paris Exposition last year. The characteristics of the lamps are said to be highest luminosity, greatest economy and reliability. Descriptive matter will be mailed upon advices to the company, which will gladly furnish any information which may be desired.

THE NEW YORK CENTRAL RAILROAD COMPANY has recently issued No. 15 of its "Four-Track" series. This folder is devoted in part to the Pan-American Express, which leaves New York every day in the year at eight o'clock P. M., arriving in Buffalo at 7.25 A. M. on the following day. The pamphlet is well illustrated with views of the exposition and contains a map of the United States and Canada, on which a circle has been drawn to scale, 500 miles in diameter, with Buffalo as the central point. A footnote states that within 500 miles of Buffalo will be found more than one-half the population of the United States, and more than three-fourths of Canada's population. This folder will be sent postpaid to any address in the world on receipt of a postage stamp by Mr. George H. Daniels, general passenger agent. Mr. Daniels's address is Grand Central Station, New York city.

THE AMERICAN BRIDGE COMPANY, 100 Broadway, New York, advises that it has recently received orders for the Liberty street bridge, which will be built by the Pennsylvania Railroad Company, at Pittsburgh, Pa., and the viaduct to be erected over the Chesapeake & Ohio tracks at Newport News, Va., by the Albany Bridge and Iron Company. This latter bridge will require two 153-foot spans, two 66-foot spans, ten 31-foot spans, and seven 30-foot spans. When the viaduct is completed it will have a 36-foot clear roadway and two 10-foot sidewalks. The company will also furnish all the steel work for structural purposes for the new Astor Building on the corner of Fifty-fifth street and Fifth avenue in New York. This will amount to about 3,000 tons, and some 2,000 more will be required for the new Custom House in New York, which is now in process of construction. Besides these orders, one has come from Logan, Utah, for the main building of a beet sugar factory, 60 to 75 feet wide, and 275 feet long; a boiler-house roof, 42 by 101 feet; a lime kiln building, 41 by 84 feet, and a warehouse roof, 52 by 144 feet.